FREDERICK COUNTY
Division of Utilities and Solid Waste Management

CITY OF FREDERICK
Department of Public Works

MONOCACY SEWERSHED WASTEWATER UTILITY STUDY PHASE II

FINAL REPORT

August 2013

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FREDERICK COUNTY AND CITY
MONOCACY SEWERSHED
WASTEWATER UTILITY STUDY
PHASE II

TABLE OF CONTENTS

List of Figures

List of Tables

Executive Summary

The Monocacy Sewershed Wastewater Utility Study for Frederick County and the City of Frederick wastewater collection and conveyance system has been conducted by Whitman, Requardt & Associates (WR&A) in two Phases, as defined below:

Phase I: WR&A completed Phase I of this study in January 2012. The purpose of Phase I was to perform sewer modeling to identify areas within the County/City system that require attention, both under present conditions and to accommodate future growth. A sewer hydraulic model of the Monocacy Sewershed was created and the model was used to analyze the capacity of the collection system. Capacity issues were identified under both present conditions and future conditions to accommodate future growth. The Ceresville PS and City Wastewater Treatment Facility (WWTF) headworks were also analyzed for capacity, with capacities at the City WWTF defined from previously completed studies. The Phase I report summarized the results of the initial modeling analysis. Refer to **Figure ES-1** for the configuration and location of key components of the Monocacy Sewershed.

Phase II: The purpose of this Phase II report is to use the model developed in Phase I to identify and present infrastructure improvement alternatives that should be considered to address and accommodate future growth. Phase II also establishes an order or timing in which these projects should be undertaken. Planning level costs are identified for each of the improvement alternatives under consideration.

Subsequent to the completion of the Phase I study, the County and City determined that the peak flow factors which had been developed using the March 2010 storm event resulted in overly conservative peak flow estimates. Following County and City input based on previous operational experience, WR&A established revised peaking factors for further modeling consideration. In addition, the Sanitary Load Allocation Table (SLAT) was revised slightly to provide a new basis for growth in the service area. The updated SLAT is included in Appendix A, and peak flows used in the analysis are shown below in **Table ES-1**.

A greater emphasis was also placed on focusing infrastructure improvements on the treatment capacity flow thresholds. As noted in Phase I of the project, Ballenger-McKinney is only allocated the equivalent of 18 MGD total flow based on nutrient load through the Chesapeake Bay TMDL Watershed Implementation Plan (WIP). For this reason, infrastructure improvement alternatives were suggested primarily based on timing to achieve an 18 MGD flow rate at the Ballenger-McKinney WWTP.

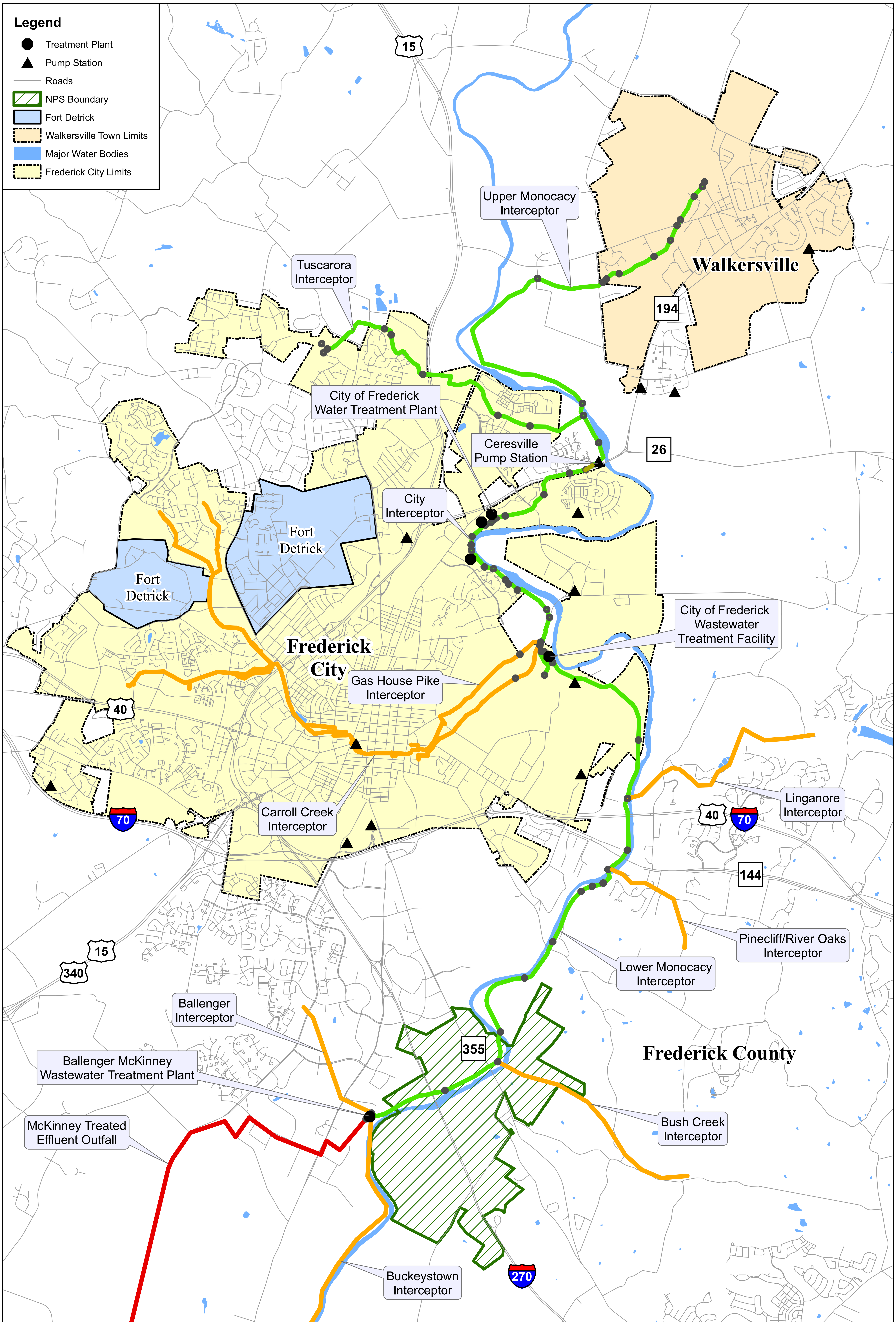

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FIGURE ES-1: Monocacy Sewershed

Table ES-1: Model Peak Flows[1] versus Time

Timestep	Ceresville PS	City WWTF Treated[2]	Bypass Flow[2,3]	Ballenger-McKinney WWTP[3]
Existing[4]	5.70	20.36	6.55	15.51
Allocated[5]	6.01	21.09	7.03	17.54
2015	7.08	22.25	8.13	23.64
2020	9.75	23.20	11.69	32.04
2024	11.31	22.98	14.29	37.08
2030	12.86	22.74	17.24	43.09
Treatment Capacity[6]	12.92	22.74	17.30	43.68
Buildout[7]	13.44	22.73	17.84	47.91

Notes:

1. *Flows are in MGD.*
2. *The City WWTF Treated flow is the flow that is discharged from the City WWTF. Bypass Flow enters the City WWTF headworks, but is pumped around to be sent to the Ballenger-McKinney WWTP. The City WWTF total influent flow (not shown) is the sum of the City WWTF Treated flow and the Bypass Flow.*
3. *Bypass flow is included in the Ballenger-McKinney WWTP flow rate.*
4. *Existing flow rate is actual measured flow at the indicated facility.*
5. *Allocated flow rate includes existing flow plus undeveloped lots that have been approved and allocated for development.*
6. *Treatment Capacity is the maximum allowable treatment flow rate as defined by the TMDL (8 MGD at the City WWTF and 18 MGD at Ballenger-McKinney WWTP). This occurs in approximately 2031 based on the SLAT.*
7. *Buildout is the ultimate buildout as defined in the SLAT. This occurs in approximately 2040.*

Results of the analysis indicated the following:

- Under allocated flow conditions the Tuscarora and Upper Monocacy Interceptors are not expected to experience any surcharging. Similarly, with present flows the simulation for the City Interceptor and the Lower Monocacy Pressure Sewer do not exhibit sanitary sewer overflows (SSOs).
- Based on nutrient load allocations in the Chesapeake Bay Total Maximum Discharge Load (TMDL) Watershed Implementation Plan (WIP), the City of Frederick WWTF and County's Ballenger-McKinney WWTP have equivalent treatment flow capacities of 8 MGD and 18 MGD, respectively. Based on the revised SLAT, combined treatment capacity (26 MGD) is expected to be reached in approximately year 2031. Under these flow conditions, the Tuscarora and Upper Monocacy Interceptors still have excess capacity. However, the City Interceptor is expected to experience three (3) SSOs - at MI-20, MI-18, and MI-17. There are also four (4) SSOs that occur on the Lower Monocacy Pressure Sewer - at the Equalization (EQ) Pumping Station, MH#45, MH#30, and MH#27, as well as three (3) SSOs that are expected to occur within gravity sewer connections into the interceptor based on the elevations for Airport Park, Whispering Creek, and River Meadows.

- The HGL in each section of the interceptor increases slightly up to the proposed build out flow, but only the Lower Monocacy Pressure Sewer is expected to have an additional SSO. The one (1) additional SSO occurs at MH#41. Based on the current SLAT, the majority of growth between the treatment capacity limit and the proposed full buildout occurs within the connecting sewer systems to the Lower Monocacy Pressure Sewer.

This study has identified areas of the Monocacy Sewershed where there will be future capacity limitations. These efforts have been based on available historical flow data, correspondence with County and City staff, planning forecasts and other assumptions as outlined herein. Based on these capacity limitations, several alternatives were developed to maintain service under future flows. Below is a list of improvements selected to prevent SSOs as noted above. The alternatives listed for the City Interceptor and Lower Monocacy are exclusive options such that only one alternative is needed for each system.

- Flow Monitoring Program
- Ceresville Pumping Station Improvements
- City Interceptor Improvement Alternatives
    - Parallel Sewer
    - Upsized Sewer
    - Water Treatment Plant PS
- Combined City Interceptor/Lower Monocacy Improvement Alternatives
    - City WWTF EQ Pumping Station
        - Minor PS Upgrades
    - Carroll Creek PS
- Ballenger-McKinney WWTP Expansion
    - Plant Expansion to 18 MGD
    - Plant Expansion to 25 MGD
    - Solids Handling Upgrades (Waste-to-Energy Option)
    - Effluent Pumping Station and Outfall

For planning purposes, timing for capital improvements discussed herein is based on the SLAT. However, actual commencement of design and ultimately implementation of improvements will be based on flow triggers, and timing will be updated regularly based on feedback from the flow monitoring program.

Table ES-2 provides a simplified summary of the cost and projected timing (based on the SLAT) of each capital improvements project associated with the lowest cost alternatives. These costs represent planning level numbers and include the following general assumptions:

- The construction cost estimates are based on January 2013 dollars (Engineer News Record Construction Cost Index 9437.27)
- A 30% construction contingency was included for each separate cost.

- Project costs (engineering, administrative, etc.) have been assumed to equal 25% of the construction cost.
- Costs for mobilization/demobilization/bonds/insurance are assumed to be 5% of the material cost.

More specific cost summaries for each project are included in Appendix C.

Table ES-2: Capital Improvements Plan Cost Summary

Project Description	**Project Costs**		
Frederick County & City CIP Projects	**0-10 Years**	**11-20 Years**	**21+ Years**
General:			
Flow Metering Program - Installation	$170,000		
Upper Monocacy Interceptor:			
Ceresville PS Upgrade - Intermediate	$300,000		
Ceresville PS Upgrade - Final			$300,000
City Interceptor:			
City Interceptor Upgrade - Parallel Sewer at Carroll Creek	$240,000		
City Interceptor Upgrade - Parallel Sewer to MI-14		$3,220,000	
Lower Monocacy Interceptor:			
Carroll Creek Pumping Station and Force Main	$26,530,000		
Ballenger-McKinney WWTP:			
Expansion to 18 MGD		$53,910,000	
Expansion to 25 MGD			$51,360,000
Solids Handling Upgrades		$30,900,000	
Effluent Pumping Station and Force Main - 10 MGD		$12,810,000	
Effluent Pumping Station - 25 MGD Upgrade and Parallel Outfall			$16,570,000
SUB-TOTAL:	*$27,240,000*	*$100,840,000*	*$68,230,000*
TOTAL:			***$196,310,000***

Notes:
1. All costs are based on January 2013 dollars (ref. ENR cost index 9437.27)
2. Project timing is based on start of design necessary to have capacity available for SLAT timing. Partial funds for project completion may be divided across adjacent columns.
3. City Interceptor Parallel Sewer to MI-14 and Carroll Creek Pumping Station are lowest cost alternatives

Recommendations for next steps include the following:

- Install reliable flow meters in locations in the County and continue use of flow meters in the City for long term flow testing to verify the flow assumptions outlined herein. Long term flow metering will provide the County and City with an on-going tool to capture peak flow events, which will provide the ability to re-calibrate the Sewer Model, as necessary, and assess results of improvements being made to the system to combat infiltration and inflow. This will be important information in order to make decisions regarding the timing of infrastructure recommended in this report.

- Periodically analyze the flow metering data to confirm peaking factor assumptions. Initially, data should be analyzed after the first 3 years of flow measurements because of key infrastructure decisions that begin in the 6-10 year range. Thereafter, flow analysis and model updates could be every 5-10 years.

- Based on the flow data and projected CIP schedule, make determinations of the appropriate alternatives to pursue as infrastructure projects. For example, if the peaking factors are determined after the 3-year assessment to be less than or equal to the assumptions included in this study, the County and City may pursue upgrades to the EQ Pumping Station at the City WWTF, since it is unlikely the screening and grit removal processes at the City WWTF would have capacity limitations. However, should the peaking factors have been understated, an expansion of the screening, grit removal, and influent pumps would be required in the future in conjunction with the EQ Pumping Station option, making the Carroll Creek Pumping Station alternative a more desirable option. A similar approach should be taken to evaluate other infrastructure improvement alternatives recommended herein.

1.0 Introduction

1.1 Project Background

The Frederick County (County) Division of Utilities and Solid Waste Management (DUSWM) and City of Frederick (City) Department of Public Works share wastewater collection and conveyance systems, which jointly make up the Monocacy Sewershed. The Sewershed consists of areas from within both the City and County and is depicted on **Figure 1-1**.

Wastewater flows from existing subdivisions within both the County and City are collected by the Tuscarora Interceptor. These flows are then combined with flows from the Town of Walkersville, which are conveyed via the Upper Monocacy Interceptor, and flow to the County's Ceresville Pump Station (PS).

Wastewater flows from the Ceresville PS are pumped a short distance, then continue via gravity to the City Interceptor, which runs through the City Water Treatment Plant (WTP) property, where the flow is measured at a Parshall flume. Wastewater from the City is then collected by the interceptor which combines with the City's Carroll Creek and Gas House Pike interceptors prior to discharge at the City Wastewater Treatment Facility (WWTF).

The City WWTF is presently set up to bypass a daily wastewater volume equal to that measured at the Parshall flume. This wastewater volume is sent to the County's Lower Monocacy Interceptor, which is a pressure sewer that runs south to the County's Ballenger – McKinney Wastewater Treatment Plant (WWTP). Wastewater from additional County interceptors is added to the Lower Monocacy Interceptor, including Linganore, Pinecliff/River Oaks, Bush Creek/Urbana, Ballenger and Buckeystown. The collection system includes gravity interceptors and several sewage pumping stations.

Treated effluent from both the City WWTF and Ballenger-McKinney WWTP is discharged into the Monocacy River, which is part of the Chesapeake Bay Watershed. Each facility is governed by a National Pollutant Discharge Elimination System (NPDES) permit, regulated by Maryland Department of the Environment (MDE). These permits define, among other parameters, the maximum nutrient (nitrogen and phosphorus) load that can be discharged into the receiving waters. The Ballenger-McKinney WWTP has been planned with the future option to send some treated effluent directly to the Potomac River. The City WWTF and the Ballenger-McKinney WWTP have nutrient load allocations, equivalent to flow capacities of 8 MGD and 18 MGD, respectively.

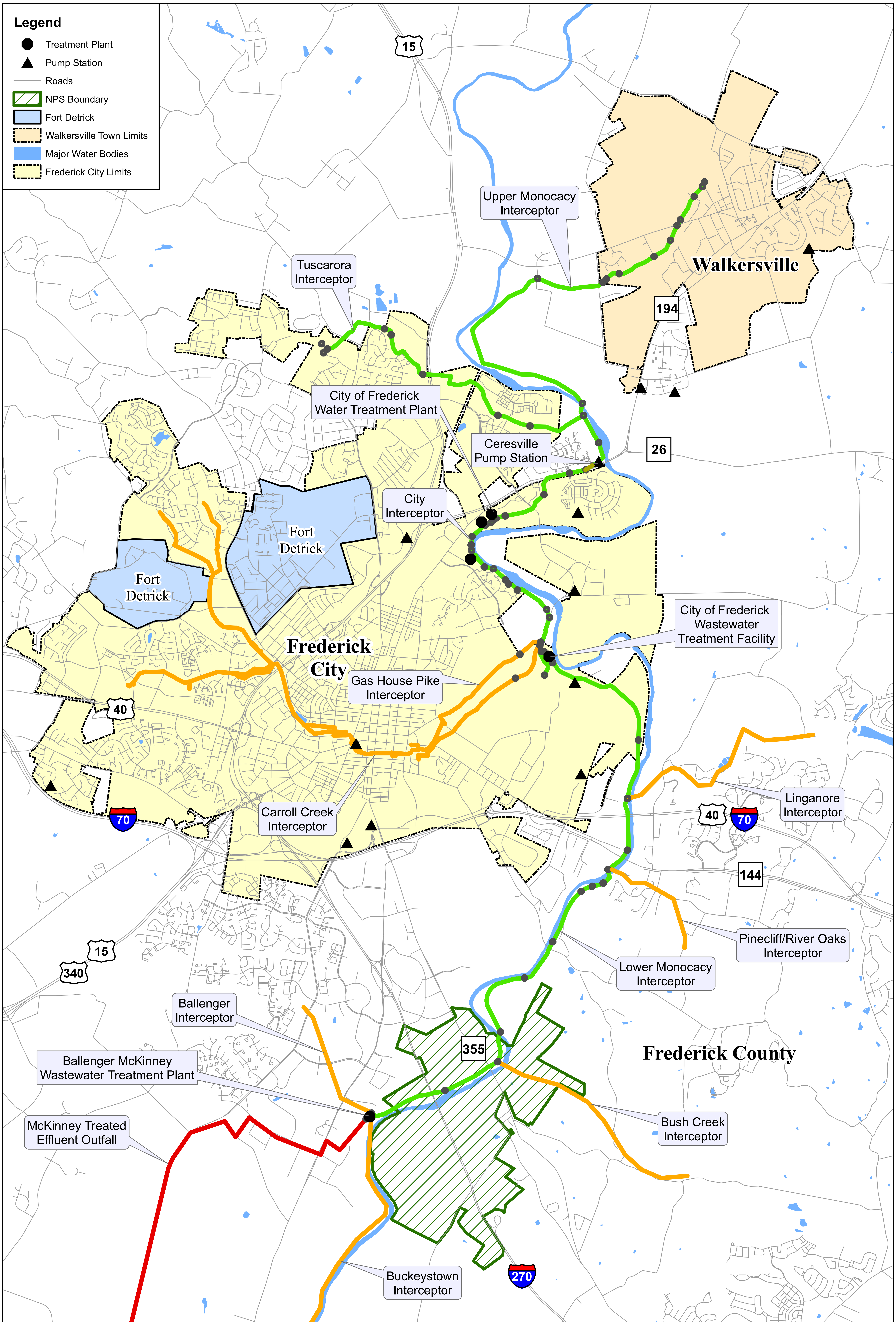

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FIGURE 1-1: Monocacy Sewershed

Portions of the Monocacy Interceptor collection and conveyance system have experienced Sanitary Sewer Overflows (SSOs) during extreme peak flow events. This study included collection and analysis of flow data from the County and City focusing on the service area within the Monocacy Sewershed. County and City staff have provided additional insight and historical perspective based on operational experience. Existing and projected flows (as defined by the Potomac River Water Supply Agreement (PRWSA)) were considered, a series of hydraulic models of the system through build-out conditions were developed, and capacity limitations in the system have been identified.

1.2 Purpose of Report

The Monocacy Sewershed Wastewater Utility Study for the County and City wastewater collection and conveyance system has been conducted in two Phases, as defined below:

Phase I: WR&A completed Phase I of this study, the purpose of which was to perform sewer modeling to identify areas within the system that require attention, both under present conditions and to accommodate future growth. These findings are summarized in a Phase I Final Report dated August 2011. An amendment to that report was completed in January 2012.

The Phase I report summarized the results of the initial modeling analysis. A sewer hydraulic model of the Monocacy Sewershed was created and the model was used to analyze the capacity of the collection system. Capacity issues were identified under both present conditions and future conditions to accommodate future growth. The Ceresville PS and City WWTF headworks were also analyzed for capacity, with capacities at the City WWTF defined from previously completed studies.

Phase II: The purpose of the Phase II report is to use the model developed in Phase I to identify and present infrastructure improvement alternatives that should be considered to address and accommodate future growth. Phase II will also establish an order or timing in which these projects should be undertaken. Planning level costs have been identified for each of the improvement alternatives under consideration. At both the County and City's request, Phase II also included some revised modeling to more accurately reflect existing flow conditions to establish more appropriate peak flow factors.

1.3 Approach and Scope of Report

Specific tasks accomplished under **Phase I** of this project included the following:

- Future wastewater flow projections were developed based on land use information, particularly areas recently annexed by the City and/or added to the County's sewer service area north of the City, including Walkersville and the proposed Century

Annexation. Flows from the remainder of the contributing areas (south of the City) were taken from existing flow projections developed for Linganore, Pinecliff/River Oaks, Urbana/Bush Creek, Ballenger Creek and Buckeystown based on the County's Wastewater Collection and Outfall Corridor Analysis Report (February 2006).

- A new sewer model for the trunk sewer system was developed utilizing SewerCAD® software which includes input flows to the trunk sewer. The effluent outfall system from the County's Ballenger-McKinney WWTP to the Potomac River was also modeled.
- The model was developed by incorporating flow monitoring data from existing meters, pump station flow records, and agreed-upon (between the County and the City) planning figures into the hydraulic model. Specific supplemental meter data were requested, and provided by the County and City. In addition, some field testing was performed.
- Near term and long term capacity problems in the existing system were identified.

Subsequent to the completion of the Phase I study, the County and City determined that the peak flow factors which had been developed using the March 2010 storm event resulted in overly conservative peak flow estimates for practical planning purposes. WR&A collaborated with the County and City based on a combination of historical data and previous operational experience to establish revised peaking factors to be used for further modeling consideration. In addition, the Sanitary Load Allocation Table (SLAT) was revised slightly to provide a new basis for growth in the service area. The updated SLAT is included in **Appendix A**. Peak flow correspondence subsequent to the Phase I Study is included in **Appendix B**.

The **Phase II Study** has been completed with the following tasks:

- Re-evaluation of the County and City sewer model using the updated peak flow factors and the SLAT, for both present and future flow conditions.
- Identification of infrastructure improvements that would address present and future capacity limitations. Planning level cost and timing have been identified for each improvement.

2.0 Existing Sewer System Conditions

2.1 Service Area Description

The entire Monocacy Sewershed consists of wastewater flows from the City, the Town of Walkersville, and outlying County areas north, east, and south of the City. The study focuses primarily on the Monocacy Interceptor system and the subsequent modeling is generally broken up into three major segments – 1) Upper Monocacy and Tuscarora Interceptors, 2) City Interceptor, and 3) Lower Monocacy Pressure Sewer. The Monocacy Interceptor system directly interfaces with three major facilities – Ceresville PS, City WWTF and Ballenger-McKinney WWTP. Many other sewage pump stations are integrated into the overall collection system. Fort Detrick owns and operates both a WTP and a WWTP that are not related to the current study. The City operates a WTP that sends filter backwash waste into the collection system. A Parshall flume flow measurement structure is located on the City's WTP property and is part of the Monocacy Interceptor system.

Figure 1-1 shows an overview of the complete service area, with emphasis on the Monocacy Interceptor and its contributing trunk lines. Major facilities, including sewage pumping stations, and major interceptors which directly feed into the Monocacy Interceptor are shown for reference. All of the wastewater collected in the Tuscarora and Upper Monocacy Interceptors flows into the Ceresville PS. The wastewater is pumped for a short segment, then the Monocacy Interceptor transitions to gravity flow and continues to the City WWTF, where City flows are treated and discharged into the Monocacy River. The remaining County flow, equivalent to the flow measured at the Parshall flume, is pumped into the Lower Monocacy Interceptor, which acts as a pressure sewer and conveys wastewater to the Ballenger-McKinney WWTP. Treated effluent from the Ballenger-McKinney WWTP is discharged to the Monocacy River.

2.1.1 Upper Monocacy and Tuscarora Interceptors

Wastewater from the northern areas of the County and City is collected in the Tuscarora Interceptor. Wastewater from the Town of Walkersville is collected in the upper segment of the Monocacy Interceptor. The Route #194 Pump Station also discharges wastewater into the Upper Monocacy Interceptor south of Walkersville. Wastewater from the Tuscarora and Upper Monocacy Interceptors combine together in Manhole MH#1 (Contract #8-S) and flow into the Ceresville PS.

Figure 2-1 shows the Upper Monocacy and Tuscarora Interceptors collection system with illustration of all manholes which collect flow inputs into the system.

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FIGURE 2-1: Upper Monocacy and Tuscarora Interceptors

N

0 1,550 3,100 6,200 Feet

2.1.2 City Interceptor

Wastewater received into the Ceresville PS includes all of the flows from the Upper Monocacy and Tuscarora Interceptors. The sewage is pumped from the Ceresville PS, where it transitions back to gravity flow and continues via gravity to the City WWTF. Sewage flows are collected directly into the City Interceptor and include pumped flow from the Deerbought subdivision, Riverside Corporate Park and periodic high rate backwash from the City's WTP. Two major interceptors connect to the City Interceptor just prior to the City WWTF – the 33-inch Gas House Pike Interceptor and the 54-inch Carroll Creek Interceptor.

Figure 2-2 shows the City Interceptor segment with illustration of all manholes which collect wastewater flow inputs into the system. A Parshall flume is shown near the City's WTP. Flow measured in the Parshall flume is considered County flow. The City WWTF stores a daily volume equivalent to that measured at the Parshall flume in a flow equalization (EQ) basin, then pumps it to the Lower Monocacy pressure sewer to ultimately be treated at the County's Ballenger-McKinney WWTP.

2.1.3 Lower Monocacy Pressure Sewer

The City WWTF pumps the County wastewater flow portion into the Lower Monocacy pressure sewer to be treated at the County's Ballenger-McKinney WWTP. Sewage flows from outlying County areas are collected by five major interceptors, which contribute to the Lower Monocacy pressure sewer – Linganore, Pinecliff/River Oaks, Bush Creek, Ballenger, and Buckeystown.

Figure 2-3 shows the Lower Monocacy Pressure Sewer segment with illustration of all manholes which collect wastewater flow inputs into the system. Treated effluent from the Ballenger-McKinney WWTP is discharged to the Monocacy River with future provisions to discharge a portion of the effluent flow through an alternate outfall to the Potomac River.

2.2 Existing Facilities

2.2.1 Ceresville Pump Station

The Ceresville PS has been in operation since 1969 and includes two (2) extended shaft centrifugal sewage pumps. The station was upgraded in 2008 to add variable speed drives and replace the pumps and pump motors. The station was originally planned for two additional pumps, but the capacity has not yet been expanded to date.

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FIGURE 2-2: City Interceptor

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FIGURE 2-3: Lower Monocacy Pressure Sewer

During normal operating conditions, the pumping station has a total operating capacity of approximately 7,200 gpm (10.4 MGD). However, the safe pumping capacity (one unit out of service) is nominally 4,800 gpm (6.9 MGD). The wet well is 20.5-feet long by 7-feet wide and the station has depth below the 39-inch sewer invert (elevation 238.93) of 6.6-feet, providing a volume within the station of just over 7,000 gallons. Because the storage volume is limited in the station, the County operates the station, consistent with the original design intent, at a water level that creates a surcharge condition in the collection system. The surcharge elevation is equivalent to the invert of an upstream manhole (MH#9, Contract #2-S), or elevation 240.84. This was assumed to be the tailwater elevation at Ceresville PS in the sewer model. Under historical high flow conditions, the second pump has been placed in operation.

2.2.2 City of Frederick WWTF

The City WWTF has been in operation since 1937 and has gone through several upgrades and expansions and currently has a treatment capacity of 8.0 million gallons per day (MGD). The facility went through its most recent upgrade to achieve Biological Nutrient Removal (BNR) effluent limits for Total Nitrogen (TN) and Total Phosphorus (TP). The upgrade was completed in 2002. The plant includes the following liquid treatment facilities:

- Screening
- Influent Pump Station
- Grit Removal
- Flow Equalization
- Primary Clarification
- Activated Sludge Biological Treatment Reactors with an A^2O Process Configuration
- Secondary Clarification
- Tertiary Filtration (Not currently in service)
- Gas Chlorination and Sulfur Dioxide Dechlorination
- Cascade Post Aeration

A Facility Plan (February 2010) was prepared to address facility improvements necessary to meet state mandated upgrades to Enhanced Nutrient Removal (ENR) requirements. Recommended improvements included the addition of the following liquid treatment facilities:

- Wet Weather Treatment System
- Activated Sludge Biological Treatment Reactors converted to a Modified Lutzack Ettinger (MLE) Process
- Bio-Augmentation Facility

- Denitrification Filter Facility
- Ultraviolet Disinfection

The City has recently initiated the design of the ENR upgrades. The preliminary treatment facilities, including Screening, Influent Pump Station and Grit Removal, receive both County and City flow contributions. The County flow is measured at the City's WTP property in a Parshall flume and an equivalent flow volume is stored in an equalization basin on the WWTF site before being pumped to the Lower Monocacy Interceptor to be treated at the County's Ballenger-McKinney WWTP. With the implementation of recent upgrades to the Influent Pump Station, the safe pumping capacity (one pump out of service) is approximately 30.5 MGD. The total pumping capacity (all four pumps operational) is approximately 36 MGD. The screening and grit removal facilities have a peak capacity of 40 MGD.

If all of the improvements identified in the Facility Plan are implemented, the influent pumps will be upgraded to a safe pumping capacity of 40 MGD, to match the capacity of the Screening and Grit Removal facilities.

The screening facility presently has a top of wall elevation of 257.25. This was assumed to be the tailwater elevation at the City WWTF in the sewer model.

The City WWTF includes a flow equalization (EQ) basin that is utilized as a holding well for County flows. The equalization basin is adjacent to a wet well, from where the County flow is pumped into the Lower Monocacy Interceptor. The pump station, referred to as Pumping Station No. 2, has a total of five (5) variable speed driven pumps. Two pumps have a nominal capacity of 5 MGD each and are typically used to pump wastewater to the County. The other three pumps have a nominal capacity of 7 MGD each and generally pump wastewater back through the City WWTF. However, all pumps are connected to a common discharge header, so there is some ability to increase capacity at Pumping Station No. 2 beyond 10 MGD. Of note, in recent field testing, the City utilized Pump Nos. 3, 4 and 5 and pumped at a rate of 11.8 MGD to the County.

2.2.3 Ballenger-McKinney WWTP

The Ballenger-McKinney WWTP has an existing capacity of 7.0 MGD. The plant is being expanded to treat an average flow of 15 MGD using membrane bioreactor technology. The current facility is designed to meet BNR requirements and includes the following liquid treatment facilities:

- Influent Pump Station

- Screening
- Grit Removal
- Primary Clarification
- 5-stage Activated Sludge Configuration
- Secondary Clarification
- Tertiary Filtration
- Ultraviolet Disinfection
- Cascade Post Aeration

The upgraded plant will meet ENR requirements and will include the following liquid treatment facilities:

- Influent Pump Station
- Screening
- Grit Removal
- Primary Clarification
- Fine Screening
- Flow Equalization
- 5-stage Activated Sludge Configuration
- Membrane Filtration
- Ultraviolet Disinfection
- Post Aeration

Effluent from the Ballenger-McKinney WWTP is discharged to the Monocacy River. Because of load allocations for TN, TP and Biochemical Oxygen Demand (BOD_5) in the discharge permit and practical limitations of technology to meet stricter effluent limitations associated with increased flow volume, the County constructed an alternative effluent line in the event that future discharges exceeding 15 MGD need to be directed to the Potomac River. Section 4.1 of the Phase I Study report provides additional information on the effluent line. A pumping station and connecting piping will need to be added in the future to allow use of the alternative effluent line.

Solids handling facilities are not being expanded as part of the 15 MGD ENR Upgrade project, but eventually will need to be expanded. The County is considering locating a Waste-to-Energy (WTE) Facility adjacent to the Ballenger-McKinney WWTP. By so doing, the WTE Facility would receive treated effluent and thickened sludge from the WWTP for use as cooling water and incineration for conversion to energy, respectively. The future solids handling improvements are conceptually based on thickening primary and waste activated sludge only, with sludge digestion and dewatering not being considered. This concept is the basis for solids handling discussion presented in this study.

As part of the ENR Upgrade construction project, a new screening and influent pumping station has been constructed and is operational. The screening facility maximum water elevation is 214.22 and this was assumed to be the Lower Monocacy Interceptor tailwater elevation at the Ballenger-McKinney WWTP for all flow simulations in the sewer model.

2.3 Initiatives Resulting from the Phase 1 Study

Two programs are already underway as a result of recommendations from the Phase 1 Study, where capacity concerns were determined under current flow conditions. The County is undergoing a project to add a third pump to the Ceresville PS, which will bring the safe pumping capacity to 7,200 gpm (10.4 MGD).

Likewise, the City is undergoing a project to add a parallel 36-inch sewer line where the City Interceptor crosses Carroll Creek. The completion of both of these projects was assumed in all Phase II modeling efforts and subsequent recommendations.

3.0 Sewer Capacity Modeling

3.1 Modeling Approach

Subsequent to the completion of the Phase I study, the County and City determined that the peak flow factors which had been developed using the March 2010 storm event resulted in overly conservative peak flow estimates. Following County and City input based on previous operational experience, WR&A drafted memoranda dated May 31, 2012 and October 19, 2012, respectively, to establish revised peaking factors for further modeling consideration. In addition, the SLAT tables were revised slightly to provide a new basis for growth in the service area. The updated SLAT table is included in **Appendix A**, while the correspondence to establish revised peaking factors is included in **Appendix B**.

A greater emphasis was also placed on focusing infrastructure improvements on the treatment capacity flow thresholds. As noted in Phase I of the project, Ballenger-McKinney is only allocated the equivalent of 18 MGD total flow based on nutrient load through the Chesapeake Bay TMDL Watershed Implementation Plan (WIP). For this reason, infrastructure improvement alternatives were suggested primarily based on timing to achieve an 18 MGD flow rate at the Ballenger-McKinney WWTP.

The City and County re-evaluated the SLAT, which has been updated to provide more realistic growth projections, to be more consistent with historical growth rates. Using the revised SLAT, the total treatment capacity of 26 MGD (18 MGD County + 8 MGD City) is expected to be reached in approximately 2031. It should be noted that the the County had previously planned to expand the Ballenger-McKinney WWTP to 25 MGD (*April 2006 Ballenger Creek / McKinney Wastewater Treatment Plant Facility Plan*) and the current SLAT projections at the WWTP are ultimately 19.7 MGD. Both values exceed the expected maximum flow capacity of the WWTP, based on nutrient loading allocations defined in the WIP. For the purposes of this report, expansions to the Ballenger-McKinney WWTP beyond the treatment capacity limitation is assumed to be 25 MGD and costs for such are included herein. Before Ballenger-McKinney can treat in excess of 18 MGD, relief on the Chesapeake Bay nutrient TMDL, future new treatment technologies that can achieve greater nutrient removal, or alternative means of effluent disposal such as water reuse would be required.

The sewer model has been run based on these revised assumptions and results are presented herein.

3.2 Modeling Inputs

Subsequent to the Phase I study, wastewater flow forecasts and peaking factors have been adjusted based on County and City input and modifications to the study approach as discussed previously. Specific inputs used in the modeling are discussed in the following sections.

3.2.1 Wastewater Flow Forecast

The initial SLAT was developed from Geographic Information System (GIS) data to determine the number of existing parcels and flow in conjunction with PRWSA data for planned growth. The interceptors feeding into the Lower Monocacy Pressure Sewer were originally reviewed in the *Wastewater Collection and Outfall Corridor Analysis Report* completed in 2006. The County cited past flow data to show that actual growth typically does not match the pace or buildout of planned projections. A summary of the wastewater flows versus time that was adopted for this study is shown in **Table 3-1**.

Table 3-1: SLAT Summary – Average Flow Rates[1] versus Time

Timestep	Ceresville PS	City WWTF Treated[2]	Bypass Flow[2,3]	Ballenger-McKinney WWTP[3]
Existing[4]	1.90	6.64	2.18	5.43
Allocated[5]	2.01	6.97	2.36	6.28
2015	2.40	7.50	2.76	8.92
2020	3.43	8.00	4.14	12.61
2024	4.04	8.00	5.17	14.63
2030	4.67	8.00	6.36	17.41
Treatment Capacity[6]	4.70	8.00	6.39	17.64
Buildout[7]	4.91	8.00	6.61	19.71

Notes:

1. *Flows are in MGD.*
2. *The City WWTF Treated flow is the flow that is discharged from the City WWTF. Bypass Flow enters the City WWTF headworks, but is pumped around to be sent to the Ballenger-McKinney WWTP. The City WWTF total influent flow (not shown) is the sum of the City WWTF Treated flow and the Bypass Flow.*
3. *Bypass flow is included in the Ballenger-McKinney WWTP flow rate.*
4. *Existing flow rate is actual measured flow at the indicated facility.*
5. *Allocated flow rate includes existing flow plus undeveloped lots that have been approved and allocated for development.*
6. *Treatment Capacity is the maximum allowable treatment flow rate as defined by the TMDL (8 MGD at the City WWTF and 18 MGD at Ballenger-McKinney WWTP). This occurs in approximately 2031 based on the SLAT.*
7. *Buildout is the ultimate buildout as defined in the SLAT. This occurs in approximately 2040.*

It should be noted that assumed timing shown is independent of the flow rates used in the model. Actual timing will likely vary from the information shown and will be verified by the flow metering program. Planning for capital improvements will be made based on actual flow triggers and not necessarily based on the timing shown in the table.

3.2.2 Peaking Factors

The peaking factors from Phase I were derived from flow data from an actual wet weather event in March 2010. The event was associated with a rain event which occurred shortly after a period of unusually heavy snow fall. The combined precipitation could have caused enough inflow and infiltration to match a 25 yr storm event. For infrastructure planning purposes, the City and County have opted to take a more cost practical approach by basing peaking factors on more typical and frequently occurring storm events. The peaking factors used for existing flow conditions were determined by the City and County based on empirical evidence (measured peak flow divided by calculated average flow), and all future timestep peaking factors were calculated using MDE's peak flow equation (shown below).

$$Q_P = 3.2 \times Q_A^{5/6}$$

$$Q_P \equiv Peak\ Daily\ Flow\ (MGD)$$

$$Q_A \equiv Average\ Daily\ Flow\ (MGD)$$

Note: PF is 2.0 for flows greater than 16 MGD, and 4.0 for flows less than 0.25 MGD.

The average flows used to calculate the peak flows were taken at the downstream collection points for the three sections of the system. The first collection point used was the Ceresville Pumping Station to set the peaking factors for the Upper Monocacy and Tuscarora Interceptors. The City WWTF flows determined the peaking factors for the City Interceptor, Gas House Pike Interceptor, and Carroll Creek Interceptor. The peaking factors within the Lower Monocacy Pressure sewer, including all connecting interceptor sewers, are defined by the flows reaching the Ballenger-McKinney WWTP. The peaking factor for each timestep was only applied to the growth during that period. **Table 3-2** shows the calculated peaking factors for each timestep at the associated locations.

Table 3-2: Peaking Factors[1] versus Time

Timestep	Ceresville PS	City WWTF	Ballenger-McKinney WWTP
Existing[2]	3	3.1	2.75
Allocated[3]	2.85	2.21	2.36
2015	2.77	2.17	2.22
2020	2.61	2.11	2.10
2024	2.54	2.08	2.47
2030	2.46	2.05	2.00
Treatment Capacity[4]	2.46	2.05	2.00
Buildout[5]	2.44	2.04	2.00

Notes:

1. *Peaking factor for each time step is for time step only and is not cumulative.*
2. *Existing peaking factor is actual based on existing conditions.*
3. *Allocated peaking factor is based on MDE equation and only applied to new connections that are allocated for development.*
4. *Treatment Capacity is the maximum allowable treatment flow rate as defined by the TMDL (8 MGD at the City WWTF and 18 MGD at Ballenger-McKinney WWTP). This occurs in approximately 2031 based on the SLAT.*
5. *Buildout is the ultimate buildout as defined in the SLAT. This occurs in approximately 2040.*

These peaking factors were applied to the average wastewater flows derived in the SLAT and summarized in **Table 3-1,** and the resulting peak flows were input into the model for analysis. **Table 3-3** summarizes the peak flows used in the model simulations.

Table 3-3: Model Peak Flows[1] versus Time

Timestep	Ceresville PS	City WWTF Treated[2]	Bypass Flow[2,3]	Ballenger-McKinney WWTP[3]
Existing[4]	5.70	20.36	6.55	15.51
Allocated[5]	6.01	21.09	7.03	17.54
2015	7.08	22.25	8.13	23.64
2020	9.75	23.20	11.69	32.04
2024	11.31	22.98	14.29	37.08
2030	12.86	22.74	17.24	43.09
Treatment Capacity[6]	12.92	22.74	17.30	43.68
Buildout[7]	13.44	22.73	17.84	47.91

Notes:

1. *Flows are in MGD.*
2. *The City WWTF Treated flow is the flow that is discharged from the City WWTF. Bypass Flow enters the City WWTF headworks, but is pumped around to be sent to the Ballenger-McKinney WWTP. The City WWTF total influent flow (not shown) is the sum of the City WWTF Treated flow and the Bypass Flow.*
3. *Bypass flow is included in the Ballenger-McKinney WWTP flow rate.*
4. *Existing flow rate is actual measured flow at the indicated facility.*
5. *Allocated flow rate includes existing flow plus undeveloped lots that have been approved and allocated for development.*
6. *Treatment Capacity is the maximum allowable treatment flow rate as defined by the TMDL (8 MGD at the City WWTF and 18 MGD at Ballenger-McKinney WWTP). This occurs in approximately 2031 based on the SLAT.*
7. *Buildout is the ultimate buildout as defined in the SLAT. This occurs in approximately 2040.*

3.2.3 Other Assumptions

Other modeling assumptions are generally consistent with assumptions described in the Phase I study (August 2011), as well as the Phase I Amendment (January 2012), which included recommendations to address immediate capacity issues. In addition, the modeling assumed infrastructure improvements have been constructed or operational changes have been implemented that are currently being pursued by either the County or City. These projects are summarized in Section 2.3 and discussed briefly below.

The County has initiated a project to install a third pump at Ceresville Pumping Station, which will increase flow output at the station and ensure that under existing conditions safe pumping capacity will be maintained.

Within the City Interceptor, two projects were considered to alleviate surcharge conditions:

First, the backwash at the City WTP can generate a significant flow over a short period of time. If this cycle were to be started during a rain event, the surcharging will be exacerbated. The City was considering an option to divert the backwash flow into a new equalization storage tank and retain it for the period of the storm event or as a minimum, pump the backwash into the sewer at a reduced, controlled rate. The City has since developed an alternative operation strategy where the backwash cycle would be delayed and if necessary, water could be received from outside sources until a rain event passed.

Second, a parallel 36-inch line was recommended at the Carroll Creek crossing, to alleviate a flow restriction within the sewer at that location. The crossing currently has a 36-inch pipe suspended from the bridge, which is smaller than the upstream and downstream sewer. The Gas House Pike Interceptor connects just upstream of this crossing and has several shallow manholes nearby. Installing a parallel crossing would increase capacity and reduce the risk of surcharging within the Gas House Pike Interceptor. The City is currently pursuing this alternative.

3.3 Results and Analysis

Sewer model outputs were developed for each time step and each segment of the Monocacy Interceptor. A summary figure was developed for each simulation. Each figure includes the following information:

- Total flow rate at the end of the segment
- Identification of major interceptor intersections

- Size of sewer pipe throughout the segment
- Station and elevation of the sewer line and finish grade
- Hydraulic Grade Line of sewer flow
- Location of important facilities
- Probable SSOs

The figures associated with the Lower Monocacy Interceptor also show the locations of known minimum elevation sewer connections feeding into the pressure sewer to illustrate whether surcharging of the pressure sewer may cause overflows in gravity sewers serving connected subdivisions. Minimum elevation connections at Bush Creek/Urbana, Ballenger, and Buckeystown Interceptors were not available at the time of this report and, therefore, were not considered in the analysis. Any surcharging should be reviewed with record drawings to determine if any impacts to gravity connections are expected. Analysis follows for each of the time steps.

3.3.1 Allocated Flow Conditions

Under allocated flow conditions the Tuscarora and Upper Monocacy Interceptors are not expected to experience any surcharging, and are depicted on **Figure 3-1** and **Figure 3-2**, respectively. Similarly, on **Figure 3-3,** with present flows the simulation for the City Interceptor does not exhibit surcharging within the system. As shown on **Figure 3-4**, the Lower Monocacy Pressure Sewer does not show any SSOs.

3.3.2 Treatment Capacity Flow Conditions

Based on nutrient load allocations in the Chesapeake Bay TMDL WIP, the City of Frederick WWTF and County's Ballenger-McKinney WWTP have equivalent treatment flow capacities of 8 MGD and 18 MGD, respectively. Based on the revised SLAT, combined treatment capacity (26 MGD) is expected to be reached in approximately 2031. Under these flow conditions, the Tuscarora and Upper Monocacy Interceptors still have excess capacity. Figure 3-1 and Figure 3-2 also illustrate the hydraulic grade line (HGL) under these conditions along the Tuscarora and Upper Monocacy Interceptors, respectively. Figure 3-3 illustrates the HGL along the City Interceptor and Figure 3-4 illustrates the HGL along the Lower Monocacy Pressure Sewer.

Under treatment capacity flow conditions, the City Interceptor is expected to experience three (3) SSOs - at MI-20, MI-18, and MI-17. It should be noted that with the parallel crossing as noted previously, there was not an SSO at Carroll Creek. There are four (4) SSOs that occur on the Lower Monocacy Pressure Sewer - at the Equalization (EQ) Pumping Station, MH#45, MH#30, and MH#27, as well as three (3) SSOs that are expected to occur within gravity sewer connections into the interceptor as shown by the elevations for Airport Park, Whispering Creek,

FIGURE 3-1: TUSCARORA INTERCEPTOR - ALLOCATED AND TREATMENT CAPACITY FLOW CONDITIONS PEAK: MH#108 (C#195R-S) TO MH#1 (C#8-S)

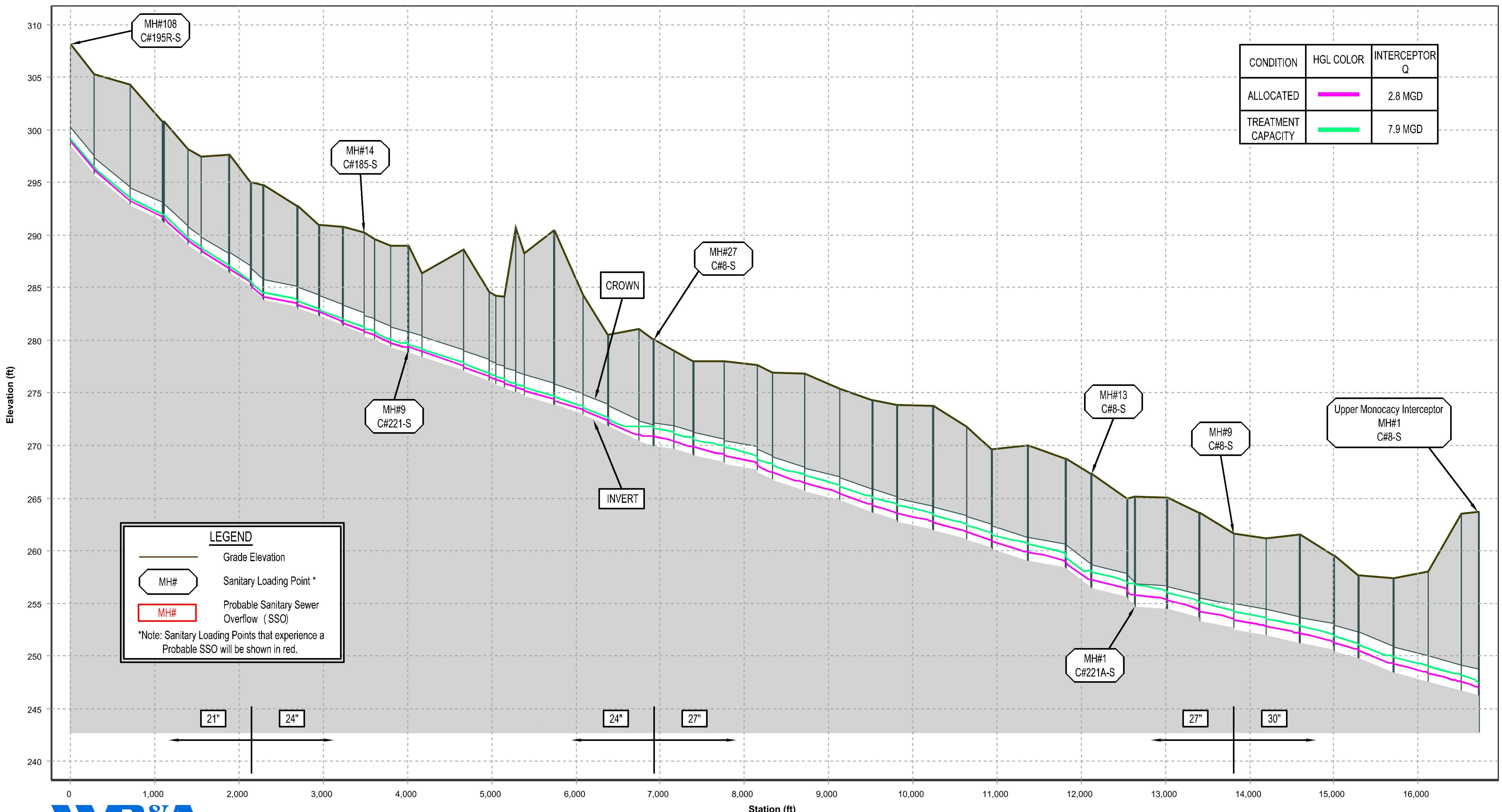

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FIGURE 3-2: UPPER MONOCACY INTERCEPTOR - ALLOCATED AND TREATMENT CAPACITY FLOW CONDITIONS PEAK: MH#54 (C#5-S) TO CERESVILLE PS

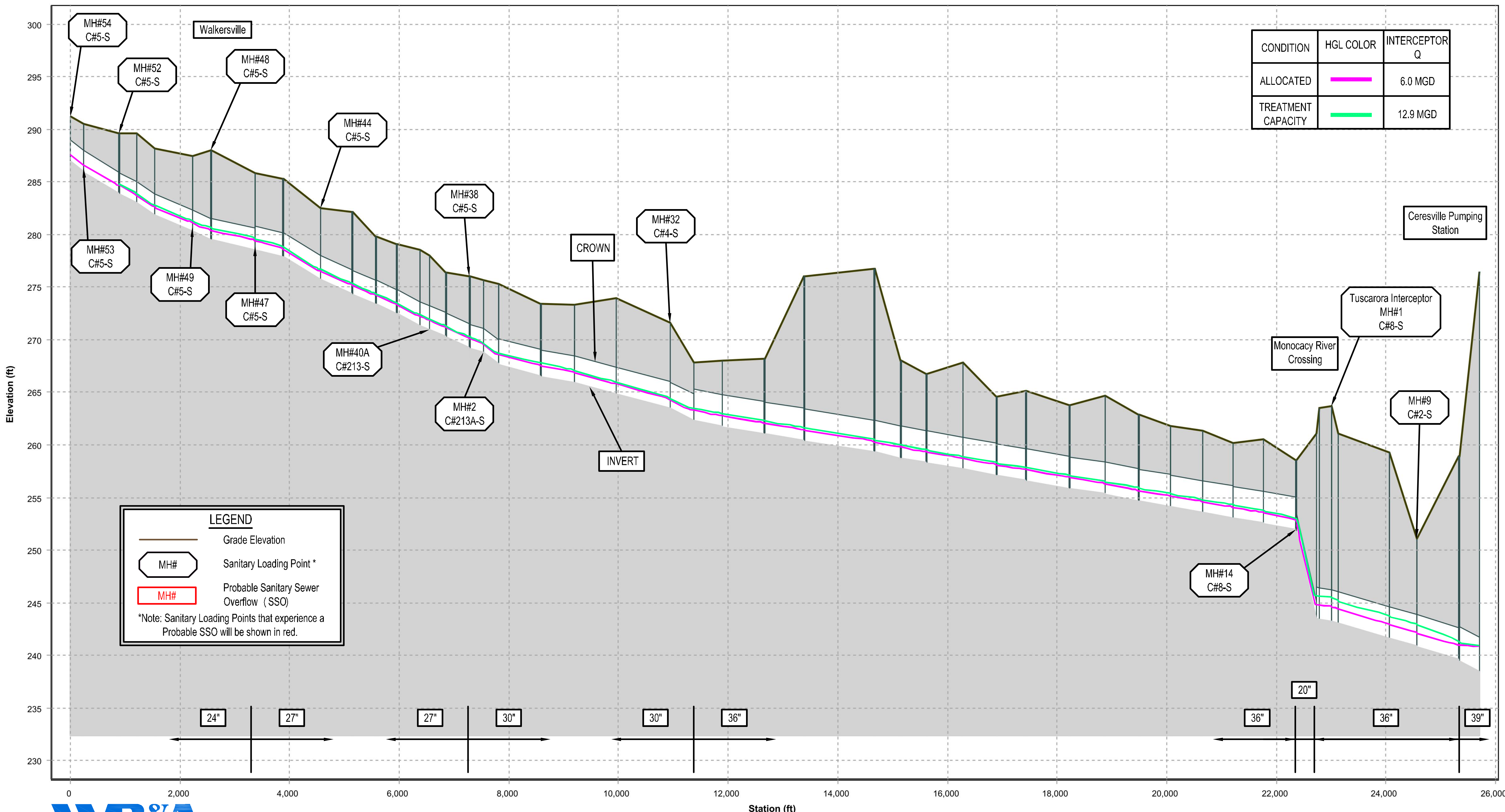

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Figure 3-2
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FIGURE 3-3: CITY INTERCEPTOR - ALLOCATED AND TREATMENT CAPACITY FLOW CONDITIONS PEAK: MH#7 (C#2-S) TO MH#3 (C#82-R)

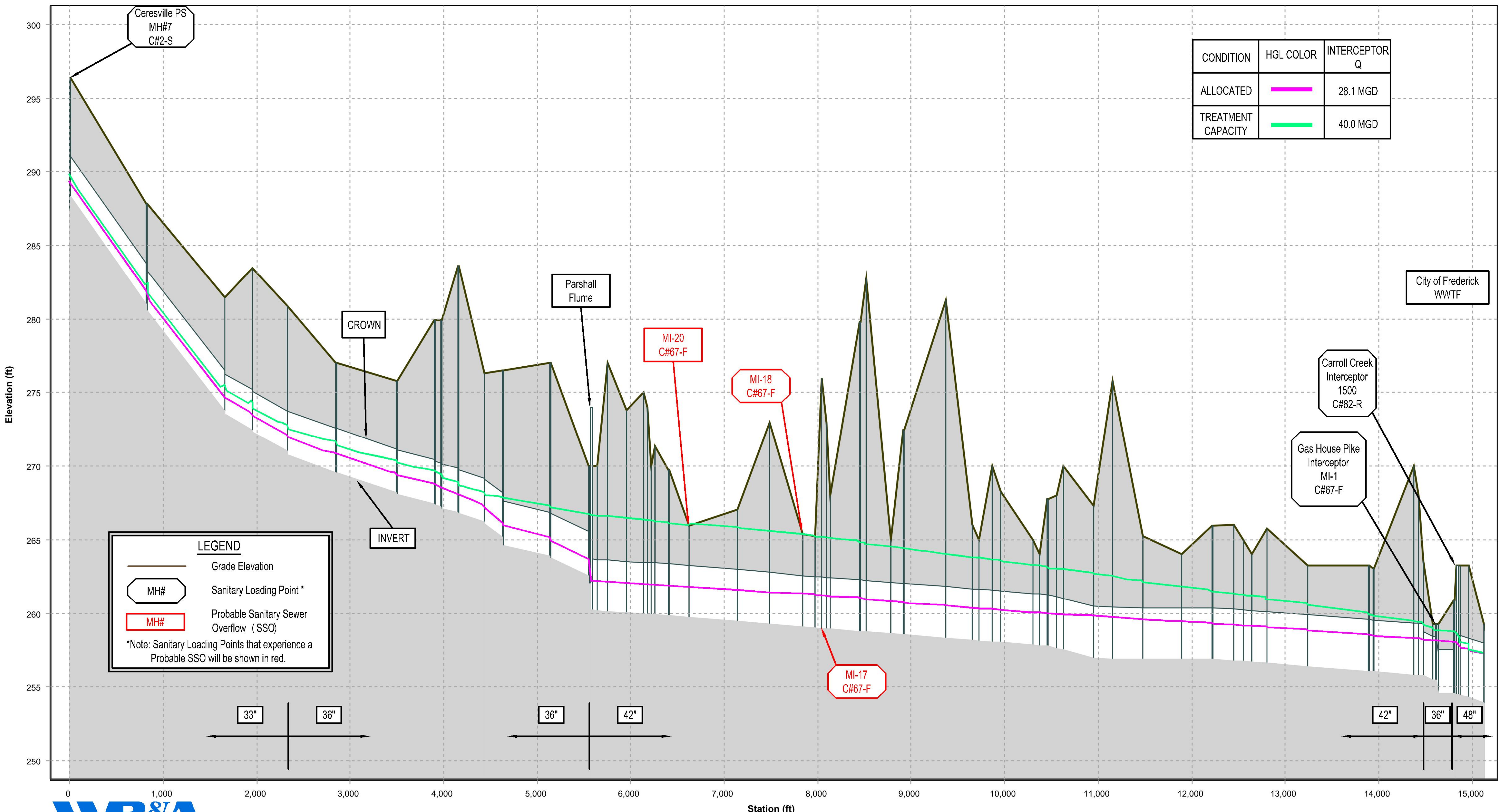

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Figure 3-3
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FIGURE 3-4: LOWER MONOCACY INTERCEPTOR - ALLOCATED AND TREATMENT CAPACITY FLOW CONDITIONS PEAK: CITY OF FREDERICK WWTF TO BALLENGER-MCKINNEY WWTP

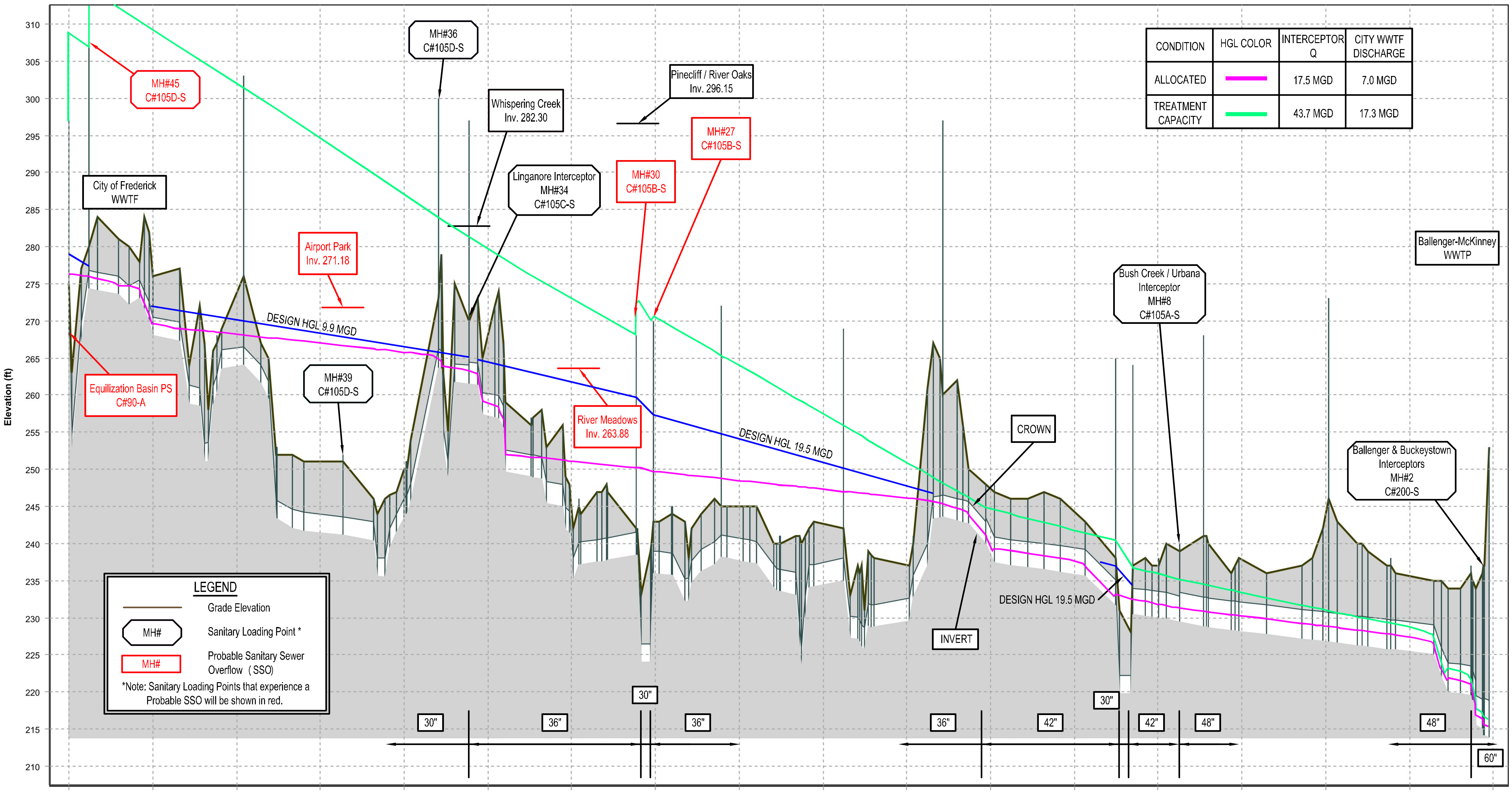

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Figure 3-4
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and River Meadows. These elevations represent the lowest gravity connections into the Lower Monocacy Pressure Sewer.

3.3.3 Buildout Flow Conditions

The HGL in each section of the interceptor increases slightly up to the proposed build out flow, but only the Lower Monocacy Pressure Sewer is expected to have an additional SSO. The one (1) additional SSO occurs at MH#41. Based on the current SLAT, the majority of growth between the treatment capacity limit and the proposed full buildout occurs within the connecting sewer systems to the Lower Monocacy Pressure Sewer.

4.0 Capital Improvements Plan

4.1 Introduction and Approach

With the sewer model having been developed as a tool, the primary task under the Phase II study was to identify infrastructure improvements that can be implemented over time to address specific capacity related needs in both the collection and treatment systems. The purpose of this section is to identify the scope, including some possible alternatives, with respective costs and timing, of recommended improvements that should be considered to address capacity issues. These improvements should be included as part of the County and City's individual and collective Capital Improvements Programs (CIP).

The primary focus of these evaluations is new infrastructure related to growth as it is assumed that maintenance or replacement of existing infrastructure is already being considered in the County and City's respective plans.

The study was set up on the premise of defined timesteps. Through review of past growth related to planning estimates, the assumed rate of growth varies and it would be best to define the timing of improvements by flow triggers. These triggers should allow sufficient time to design and construct improvements prior to the system reaching capacity in the respective section. In order to be consistent with typical evaluations of wastewater treatment plants, the flow trigger for starting design of the associated improvement is proposed to be 80%. In other words, when flow rates associated with growth achieve 80% of the existing capacity, design of the capacity upgrade should be initiated. Infrastructure improvements should be constructed and operational by the time flow triggers reach 90% of the existing capacity. This should give flexibility and a conservative amount of time to design and construct the necessary improvement(s). In the event that the time to implement an improvement is expected to take more time, or growth increases at a rapid rate, the determination of when to begin design may be based on meeting the 90% operational trigger.

4.2 Flow Monitoring Program

One of the primary recommendations from the Phase I study was the installation of permanent flow meters in each of the major contributing interceptors, and this should be part of a long term flow monitoring program. This will allow monitoring of peak flows during all storm events and periodic updating of peaking factors and re-assessment of the system capacity as warranted. The flow monitoring will also provide a mechanism to determine when the flow trigger for specific infrastructure within the system has been reached. See **Table 4-1**.

Figure 4-1 shows recommended locations for permanently mounted flow meters. In gravity portions of the collection system, the meters can be Hach FL900 Flo-Logger with a Marsh McBirney Flo-DAR sensor, similar to those installed in portions of the City collection system. Pressure sewer locations can utilize either Magnetic type or Ultrasonic strap-on type meters.

Table 4-1: Flow Triggers as Percentage of Infrastructure Capacity

Infrastructure	80% Flow Trigger	90% Flow Trigger	Existing Design Capacity[1,2,3]
City Interceptor[1]	32.0 MGD	36.0 MGD	40.0 MGD
Lower Monocacy Interceptor[1]	25.6 MGD	28.8 MGD	32.0 MGD
Ceresville PS[2]	8.3 MGD	9.4 MGD	10.4 MGD
City WWTF Headworks[2]	24.4 MGD	27.5 MGD	30.5 MGD
City WWTF EQ PS[2]	9.6 MGD	10.8 MGD	12 MGD
Ballenger-McKinney WWTP[3]	12 MGD	13.5 MGD	15 MGD

Notes:

1. *Interceptor capacities are peak flows at the downstream collection point defined by the occurrence of a SSO.*
2. *Facility capacities are defined by design hydraulic capacity or safe pumping capacity, whichever is less.*

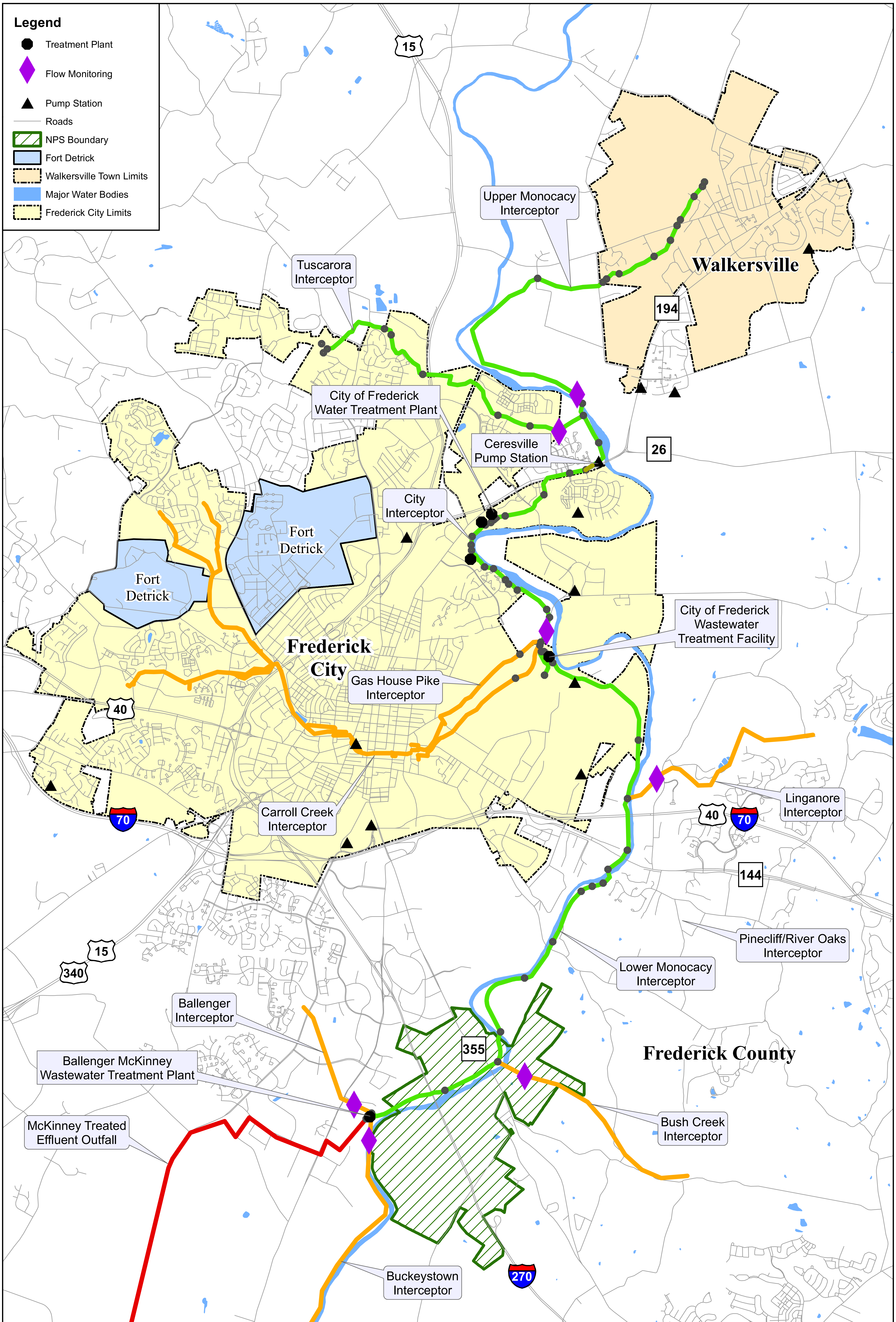

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FIGURE 4-1: Proposed Flow Monitoring Program

N
Feet
0 2,000 4,000 8,000

3. *Ballenger-McKinney WWTP capacity is defined by current planned expansion. Additional City WWTF expansion is not planned to be expanded beyond 8 MGD and therefore, is not shown.*

Comparing these flow triggers with Table 3-3, the existing peak flows at the City WWTF headworks currently exceeds the 80% initiate design criteria.

4.3 Ceresville Pumping Station Improvements

As noted in Section 3, the Tuscarora and Upper Monocacy Interceptors are not expected to have SSOs or even surcharging through buildout. The pump station is currently in the process of being upgraded by the County by installing a third pump, which will bring the safe pumping capacity to 7,200 gpm or 10.4 MGD. As peak flows increase over time the fourth pump can be installed. The fourth pump will increase the safe pumping capacity to 8,900 gpm (12.8 MGD), and the total capacity of the pump station will be 9,600 gpm (13.8 MGD). The peak flow under the treatment limit condition is 12.9 MGD, which minimally exceeds the safe pumping capacity. The original design of the pump station allowed for surcharging upstream to increase the storage capacity of the wetwell. It is assumed that the pump station could surcharge the upstream system for a brief period during the peak hour and be able to safely pump flows under normal conditions. However, peaking factors should continuously be monitored and adjusted as necessary to ensure actual flows are not being under estimated.

4.4 City Interceptor Improvement Alternatives

As shown on Figure 3-3, sewer modeling at Treatment Capacity Flow conditions indicated that there are three (3) SSOs predicted, at manholes MI-20, MI-18, and MI-17. Based on the projected growth rates, these are expected to occur between 2024 and the Treatment Capacity flow rate. Two alternatives have been considered to address these SSOs: installing a parallel relief sewer and upsizing the existing line.

4.4.1 Parallel Sewer

As growth leads to more surcharging and a greater chance of SSOs, one alternative is to install a parallel relief sewer that will reduce the HGL within the interceptor. The SSOs will be removed from the City Interceptor if it is paralleled with a 24-inch relief sewer from MI-14 to the Carroll Creek Crossing (5,560 LF), as shown on **Figure 4-2**. In this case the parallel relief sewer is matching crown elevations with the 42-inch interceptor sewer. **Figure 4-3** depicts the HGL within the City Interceptor during the Treatment Capacity Flow condition simulation.

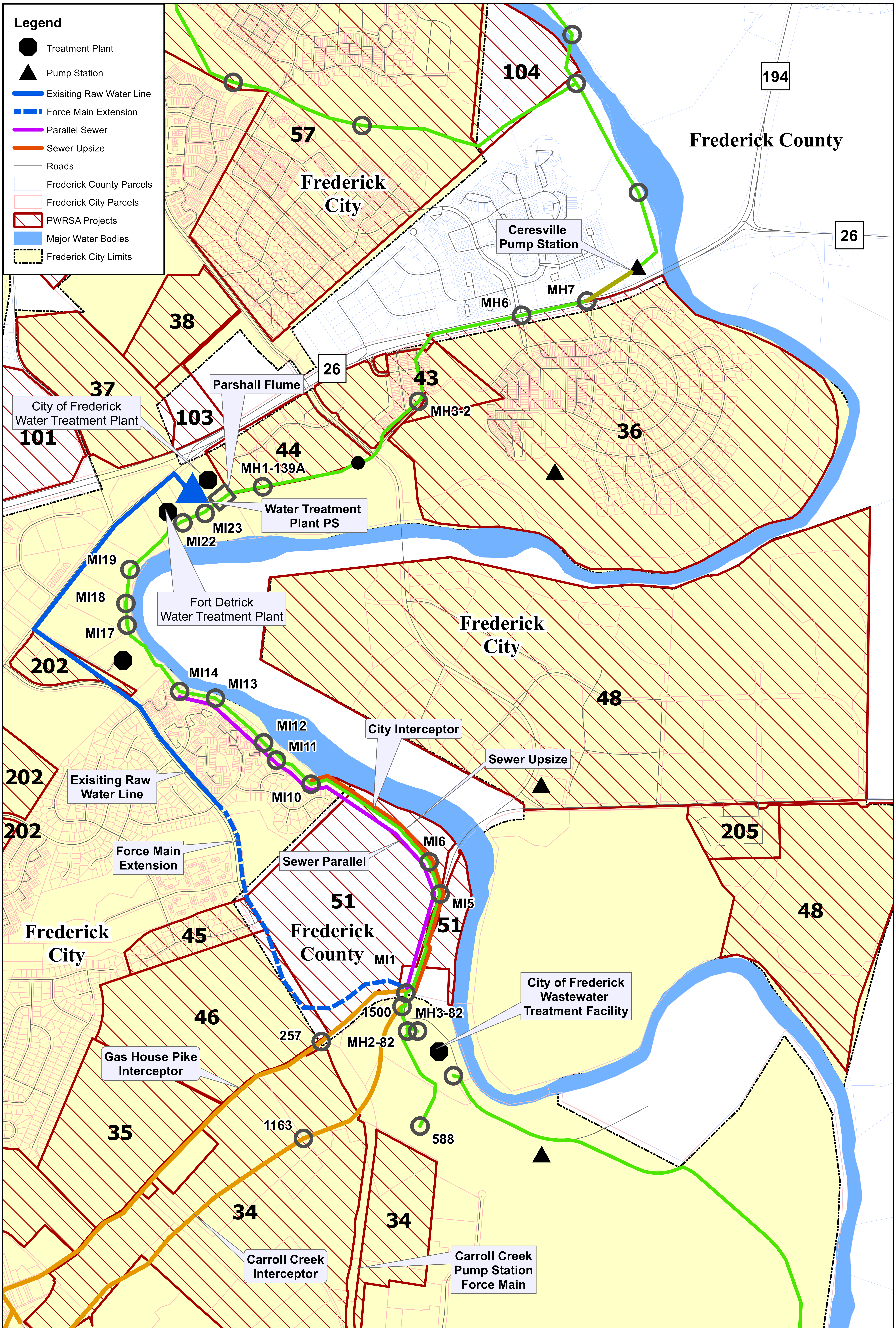

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Figure 4-2: City Interceptor Improvements Plan

FIGURE 4-3: IMPROVED CITY INTERCEPTOR - TREATMENT CAPACITY FLOW CONDITIONS:
MH#7 (C#2-S) MH#3 (C#82-R)

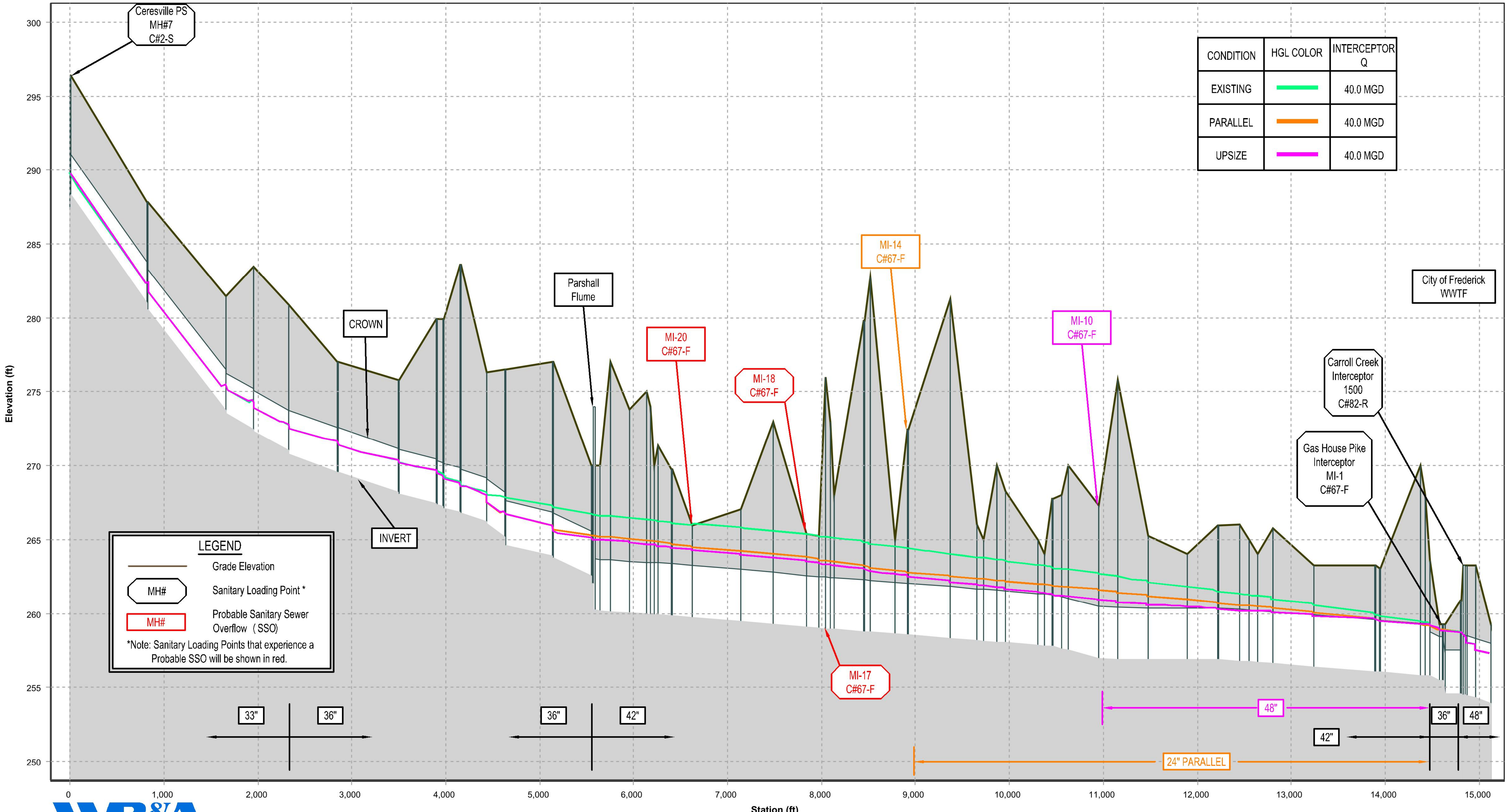

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Figure 4-3
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4.4.2 Upsized Sewer

The City and County have expressed concern with the age of the existing City Interceptor Sewer since most of the system consists of concrete pipe that was installed in the late 1960's and early 1970's. Installing a parallel relief sewer would not address any issues with the age and life cycle of the existing pipe, but would allow for flow bypass so the existing sewer could be rehabilitated. In lieu of a relief sewer, the interceptor could be upsized (utilizing local pump-arounds) to a 48-inch pipe from manhole MI-10 down to the Carroll Creek Crossing (3,650 LF) to remove the SSOs, as shown on Figure 4-2. The effects of the upsizing on the HGL is shown on Figure 4-3. Upsizing the existing pipe will be more costly than paralleling the interceptor due to bypass pumping and more expensive material, but may be comparable to the cost of replacing the existing 42-inch sewer in kind.

4.4.3 Water Treatment Plant PS

An alternative to increasing capacity of the gravity sewer system is to remove flow from the system prior to an SSO location. A wet weather relief pump station was proposed that could be sited within the City WTP property upstream of MI-20. In this instance only 2.8 MGD of flow would be removed from the gravity system in order to prevent SSOs and redirected back into the system at the City WWTF influent PS. The total length of the required 12-inch force main is 10,200 LF, but an abandoned raw water main could be repurposed to reduce the length of new piping to 4,100 LF. Additional review of the raw water main will be required to determine if the existing line is feasible for conveying wastewater under the proposed conditions. The approximate location of the pump station and alignment of the force main are included on Figure 4-2 with the limits of the raw water main shown. **Figure 4-4** depicts the effect of the redirection of flow on the HGL in the system.

4.5 Combined City Interceptor/Lower Monocacy Improvement Alternatives

As shown on Figure 3-4, sewer modeling at treatment capacity flow conditions indicated that there are four (4) SSOs predicted: at the EQ Pumping Station, MH#45, MH#30, and MH#27. Based on the projected growth rates, these are expected to occur between years 2024 and 2031, with the exception of the EQ Pumping Station. The EQ Pumping Station discharge stack is expected to overflow between 2020 and 2024. These SSO conditions are the result of both the flow rate that is being bypassed around the City WWTF and the location at which these flows are introduced into the Lower Monocacy Interceptor. Two alternatives have been considered to address these SSOs: 1) Construction of a new EQ Pumping Station with a new force main and 2) Construction of a new pumping station upstream of the City WWTF with a new force main. In both alternatives, the force main would discharge to a specified manhole further downstream

FIGURE 4-4: IMPROVED CITY INTERCEPTOR - TREATMENT CAPACITY FLOW CONDITIONS:
MH#7 (C#2-S) MH#3 (C#82-R)

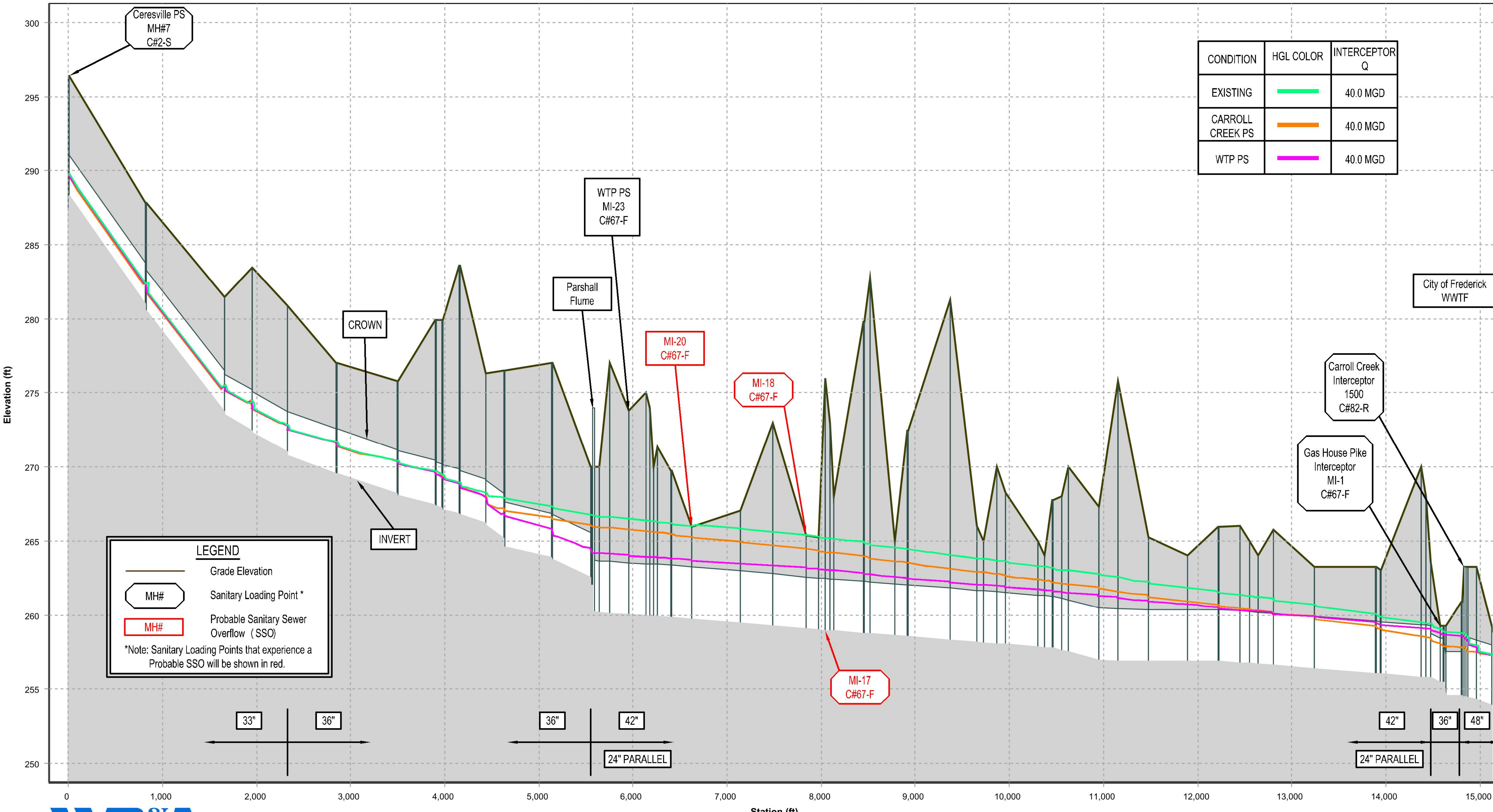

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Figure 4-4
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on the Lower Monocacy Interceptor. **Figure 4-5** shows conceptual plans for each of these alternatives.

4.5.1 City WWTF EQ Pumping Station Upgrades

The EQ Pumping Station at the City WWTF currently bypasses all County flows as measured at the parshall flume near the City's WTP. As growth occurs, the capacity of the City WWTF will be reached and any excess flows will be pumped into the Lower Monocacy Pressure Sewer with the County flows for treatment at the County WWTP. The existing capacity of the EQ Pump Station is approximately 12 MGD, and this flow is expected to be reached by year 2020. An upgrade will be required to continue bypassing all flow through the EQ Pumping Station beyond this point. The projected peak flow under treatment capacity flow conditions is 17.32 MGD. The City is considering the design of a second screening facility with a new pump station that will initially have a safe pumping capacity of 10 MGD. An additional upgrade will increase the safe pumping capacity of the new pump station to 17.5 MGD as needed. The addition of the new screening facility will redirect flows away from the existing influent pump station and ultimately reduce the peak flow experienced by the pump station.

Simulations of the Lower Monocacy Pressure Sewer indicate that the introduction of future EQ Pumping Station flows at the start of the interceptor will cause SSOs. In order to prevent these SSOs, by the year 2024, flows from the EQ Pumping Station will need to be pumped downstream via a new force main connection approximately 12,250 linear feet to MH#31. This new connection is downstream of the intersection with the Linganore Interceptor, allowing it to remain as a gravity sewer junction. A profile of this simulation is shown on **Figure 4-6**. Once the treatment capacity limit is reached, the force main will have to be extended an additional 1,750 ft. to MH#23 to maintain gravity flow connections, as shown on **Figure 4-7**.

4.5.2 Carroll Creek Pumping Station

As an alternative to upgrading the City WWTF headworks and constructing a new Equalization Pumping Station to bypass County and excess City flows, a new pumping station can be installed along the Carroll Creek Interceptor. The average flow at the treatment capacity limit within the Carroll Creek Interceptor (6.35 MGD) is comparable to the combined County and City excess flow (5.09 MGD + 1.30 MGD = 6.39 MGD). A pumping station could be installed near where the interceptor crosses Farm Lane with a force main following the road south, continuing on Monocacy Boulevard to the intersection with Reichs Ford Road, and then south along Reichs Ford Road until reaching the pressure sewer near MH#20. The total length of the force main is 16,250 ft, but it would not need extensions under future flows. The bypassed flow would enter the system far enough downstream to prevent surcharging within the Linganore Interceptor, as

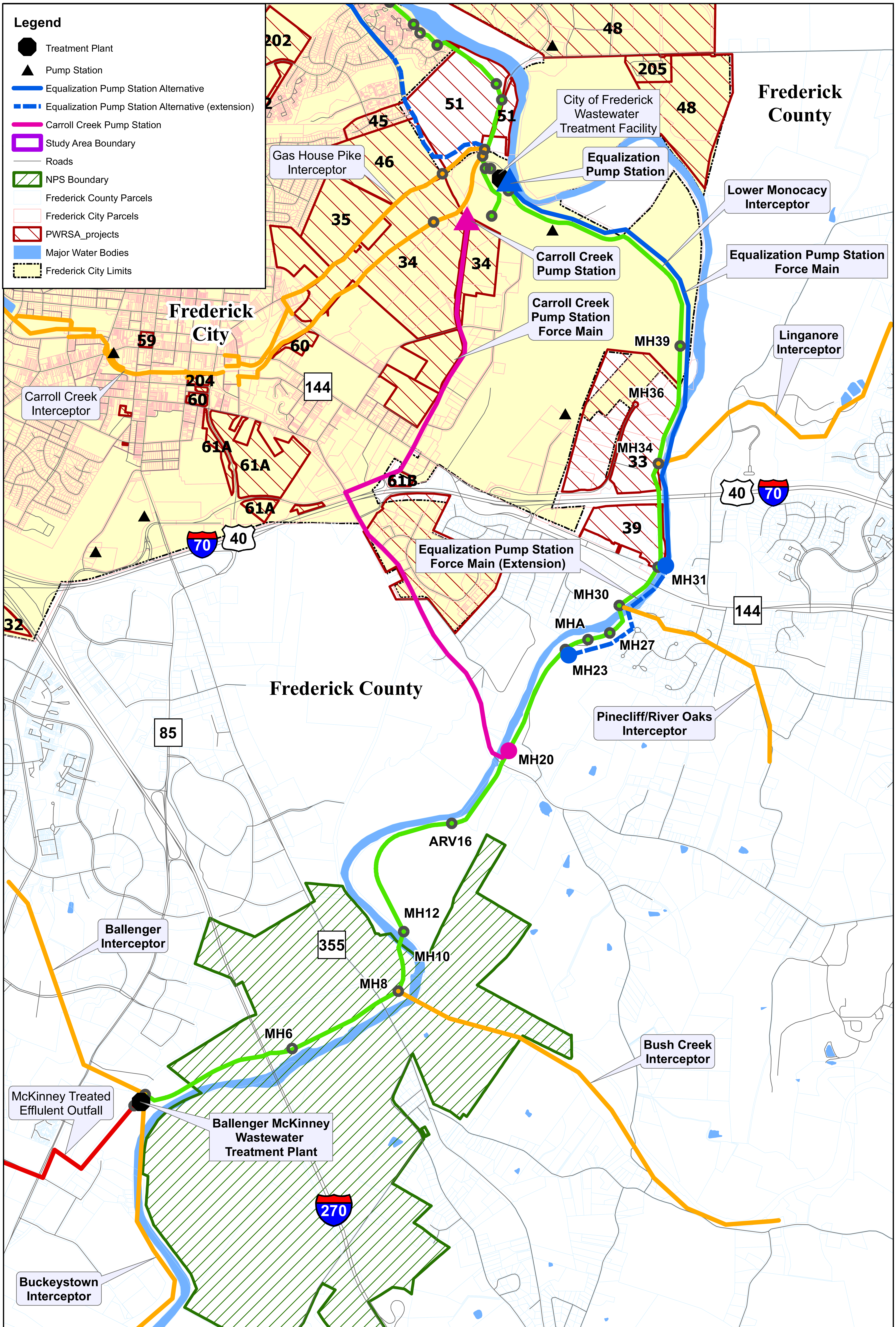

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Figure 4-5: Lower Monocacy Improvments Plan

N

Feet
0 1,000 2,000 4,000

FIGURE 4-6: EQ PUMPING STATION EFFECT ON LOWER MONOCACY INTERCEPTOR AT 2024 FLOW

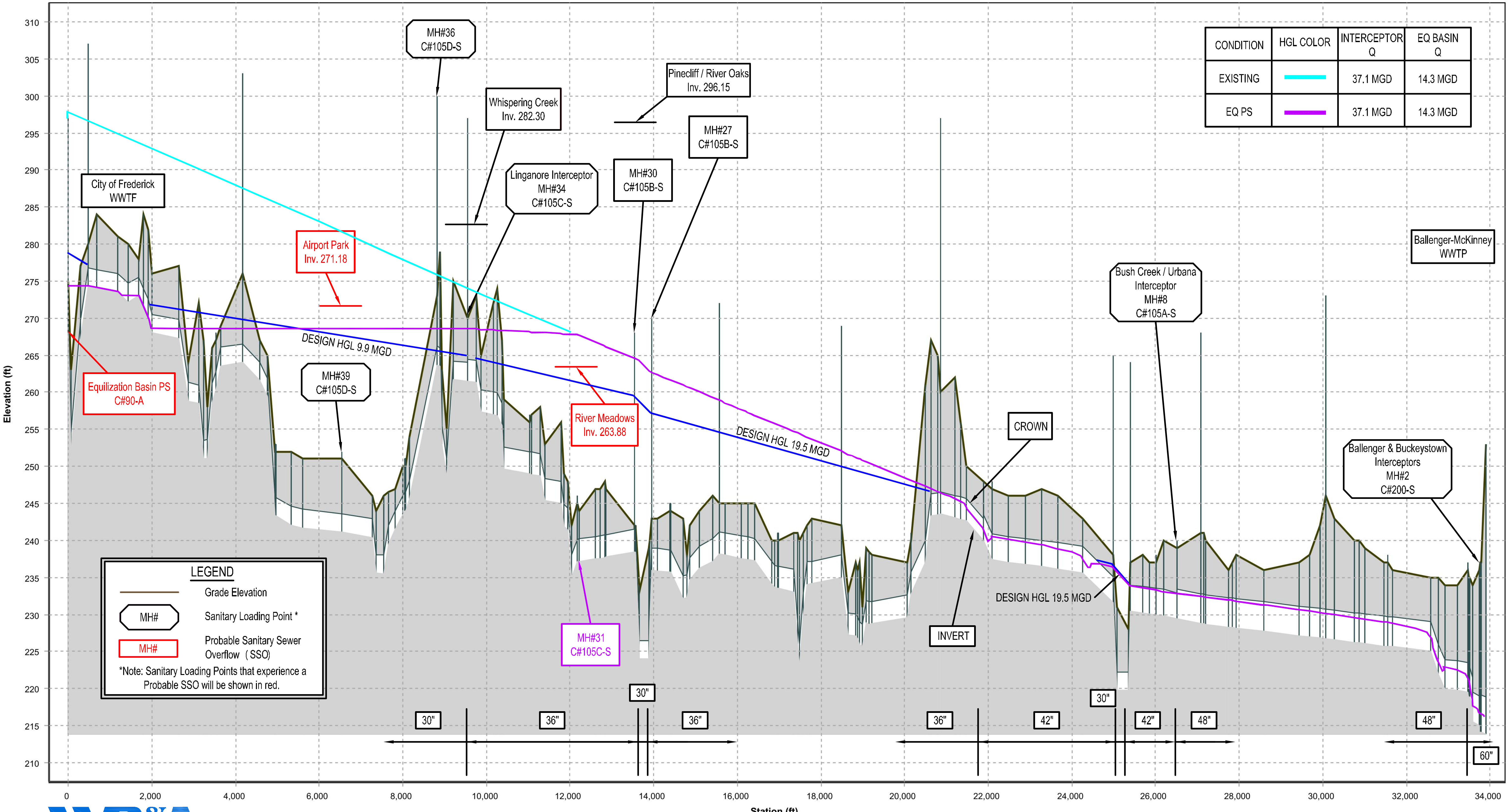

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Figure 4-6
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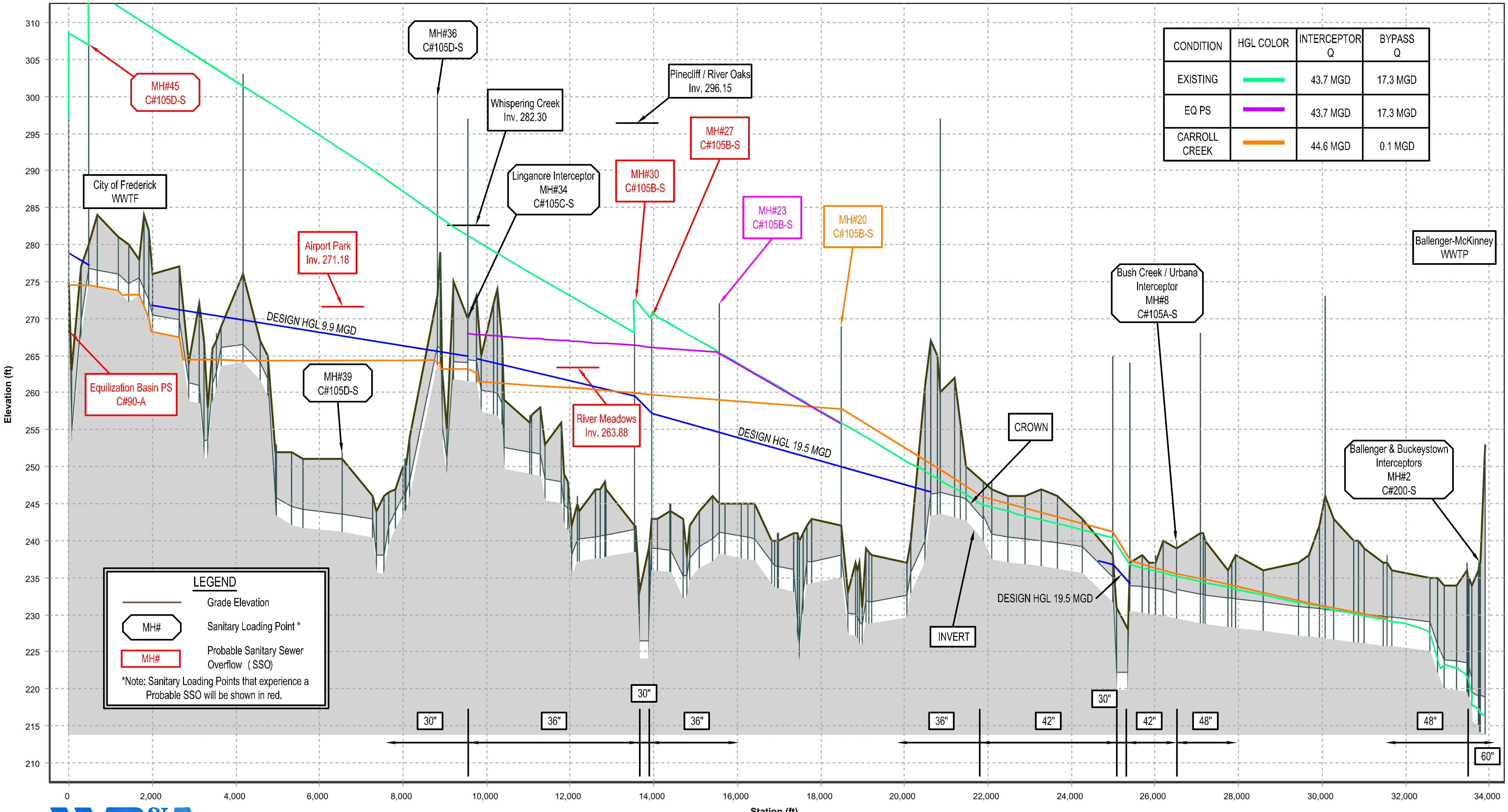
FIGURE 4-7: EQ AND CARROLL CREEK PUMPING STATION ALTERNATIVES EFFECT ON LOWER MONOCACY INTERCEPTOR AT TREATMENT CAPACTIY FLOW



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shown on Figure 4-7. The installation of this pumping station would remove flow from the City Interceptor and reduce the HGL below SSO levels,possibly preventing the need to provide additional improvements to the gravity sewer. The model indicates that during treatment capacity flow conditions the HGL would rise to within one foot of the rim elevations, so additional upgrades may still be warranted. In this report it is assumed that gravity sewer improvements are required in conjunction with the Carroll Creek Pumping Station and are included in the costs. The flow monitoring program will provide useful data to ultimately determine whether the gravity sewer improvements would be necessary.

As noted above, the flow from the Carroll Creek Interceptor is less than the projected flow required to be directed to the Lower Monocacy Pressure Sewer, so the current use of the Equalization Pumping Station will need to be maintained.

Alternatively, a pumping station could similarly be installed along the City Interceptor. The purpose would be to intercept excess flows in the City Interceptor upstream of the WWTF (including all County flows) and bypass them around the City WWTF. This option was not pursued in this study, because it would be similar in magnitude and cost to the Carroll Creek PS.

This alternative assumes that the improvement will be in place prior to requiring an upgrade to the City WWTF headworks. As noted in section 4.2, the City WWTF headworks has exceeded the 80% initiate design criteria. This will require the Carroll Creek PS upgrade to be initiated much sooner to prevent additional improvements at the City WWTF. Another option would be to move forward with the upgrade at the City WWTF headworks and delay the need to initiate design of the Carroll Creek PS until the 80% flow trigger of the Lower Monocacy Interceptor, where flows will be redirected downstream or the 80% flow trigger of the EQ Pumping Station is reached, where flows will be diverted away from the City WWTF.

4.5.3 Minor PS Upgrades

In some of the above alternatives, the HGL within the Lower Monocacy Pressure Sewer may have exceeded the lowest invert of the gravity sewer connections. An example would be the River Meadows connection as shown in red on Figure 4-5. In this case, a small pump station to serve River Meadows would be proposed to prevent SSOs from impacting the individual gravity sewer connections.

4.6 Ballenger-McKinney WWTP Expansion

The Ballenger-McKinney WWTP is presently under construction to expand treatment capacity to 15 MGD. The new influent pumping station, grit facility, primary clarifiers and fine screening facility are constructed and operational at this time. The secondary plant expansion including modifications to the biological reactors, membrane treatment facilities, UV disinfection and post aeration are anticipated to be complete in 2015. Following wastewater forecasts in Table 3-1, the current plant expansion is expected to provide capacity to 2024, but the County should consider timing to complete the next phased expansion before capacity is reached. **Figure 4-8** shows a site plan of the Ballenger-McKinney WWTP with conceptual planning and phasing from the current expansion through the treatment capacity flow (18 MGD) and to 25 MGD.

4.6.1 Plant Expansion to 18 MGD

Preliminary site planning has been done with facility planning efforts for the current plant expansion to conceptually further expand the Ballenger-McKinney WWTP up to 25 MGD, or projected build-out flow rate. However, under the Chesapeake Bay TMDL WIP, the nitrogen and phosphorus loads allocated to the plant effectively limit the flow rate to 18 MGD at ENR levels of treatment. Under the current expansion, the infrastructure for the Influent Pumping Station, Grit Facility and Fine Screening Facilities has been sized for the full build-out conditions, with space allotted for installation of additional equipment when needed. An intermediate expansion to 18 MGD would require:

- Addition of one (1) coarse screen
- Addition of one (1) influent pump
- Addition of one (1) grit tank with mechanism
- Addition of one (1) fine screen
- Addition of biological reactors (5 MGD)
- Addition of membrane and U V facilities (5 MGD)

This assumes the additional primary clarifier and post aeration systems can be deferred to a full 25 MGD expansion and that the oversized biological reactors can handle the additional Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) load carried over from higher flux through the primary clarifiers.

4.6.2 Plant Expansion to 25 MGD

The need to expand the Ballenger-McKinney WWTP to 25 MGD would require some relief on the Chesapeake Bay nutrient TMDL, future new treatment technologies that can achieve greater nutrient removal, or alternative means of effluent disposal such as water reuse. In the event that the facility could be expanded to 25 MGD in the future, additional facilities would include:

- Addition of one (1) influent pump
- Addition of one (1) primary clarifier
- Addition of biological reactors (5 MGD)

Ballenger-McKinney WWTP Conceptual Future Site Plan

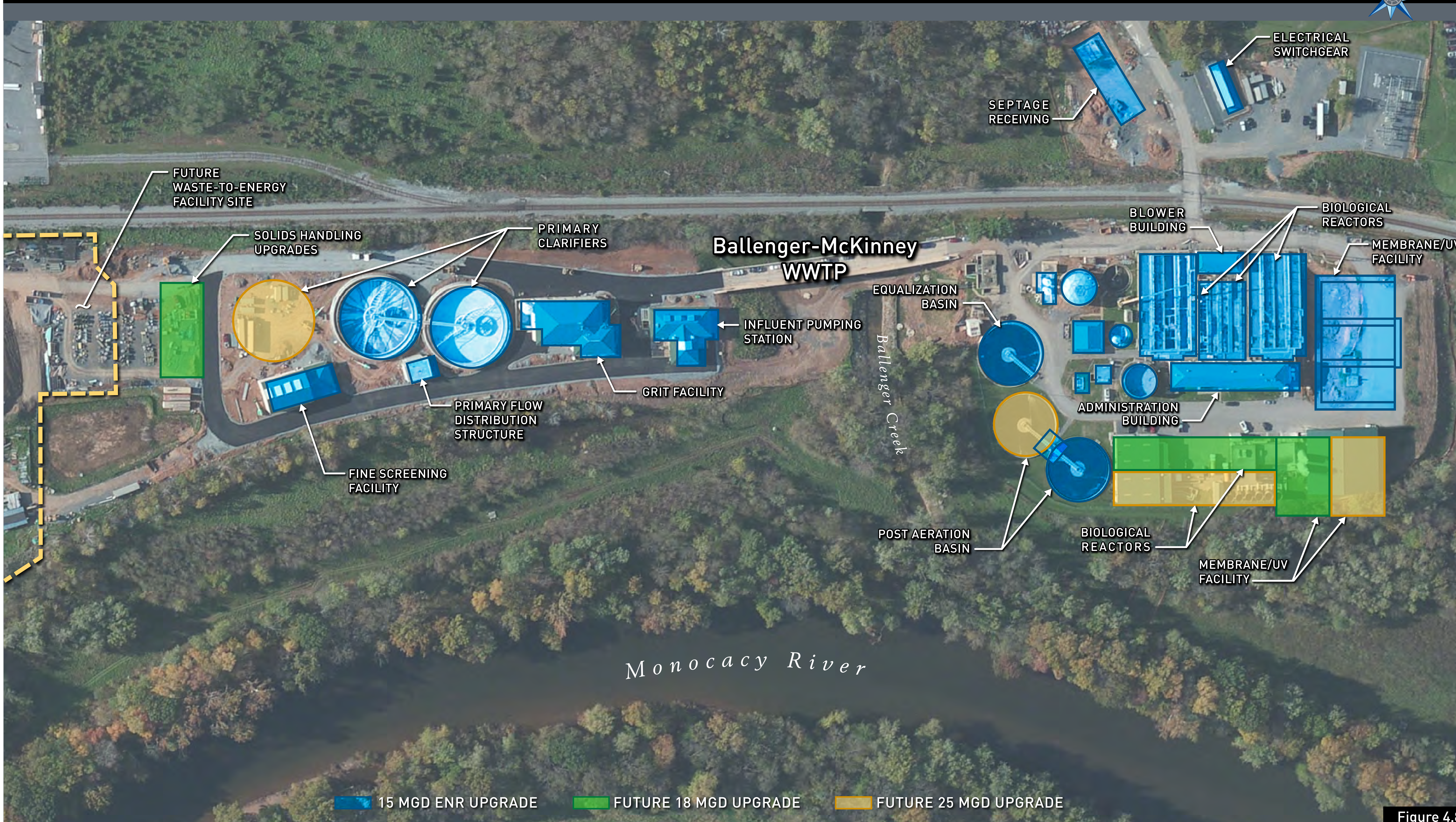

Figure 4.8

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- Addition of membrane and UV facilities (5 MGD)
- Conversion of a final clarifier to a second post aeration system

4.6.3 Solids Handling Upgrades (Waste-to-Energy Option)

The present ENR Upgrade project at Ballenger-McKinney WWTP does not include upgrades to the solids handling facilities within the Ballenger-McKinney WWTP. Rather, the existing facilities will remain in service until such time as the solids facilities will be expanded. Prior to the next plant expansion, it is anticipated that the existing solids handling facilities will be demolished, relocated, and expanded to make room for future biological reactors and membrane/UV facilities.

Frederick County is planning to site a WTE Facility adjacent to the Ballenger-McKinney WWTP. The WTE Facility would use both treated effluent for cooling water and take treatment plant waste solids (minimum of 3% concentration) and convert it to energy. The future solids handling upgrades are highly dependent on decisions made with respect to the WTE Facility. A memorandum dated August 2009 developed solids handling design criteria for coordination with the WTE Facility. Based on that concept, solids handling would consist of separate sludge storage for both primary and waste activated sludge (WAS) streams. Both sludges would be pumped to Gravity Belt Thickeners.

Costs included in the CIP summary assume the solids handling facilities will be in support of the WTE Facility concept and would be brought on line prior to the construction of the WTE Facility.

4.6.4 Effluent Pumping Station and Outfall

The current NPDES permit for the Ballenger-McKinney WWTP restricts the effluent discharge to the Monocacy River to 15 MGD, even though there is 18 MGD of nutrient allocation available. The County has already constructed the majority of an outfall line from the WWTP to the Potomac River. However, to use the outfall, an effluent pumping station will need to be installed at the WWTP along with approximately 3,000 feet of 36-inch force main to connect to the existing line. This project is illustrated conceptually in **Figure 4-9**.

Conceptually for planning purposes, the pumping station is assumed to initially convey 3 MGD average and 10 MGD peak through the effluent outfall line. The WTE Facility is planned to take effluent (reclaimed water) from the WWTP for use as cooling water and plans to discharge blow down water back into the outfall, also to be discharged to the Potomac River. If the County is successful in the future obtaining additional discharge capability to achieve the ultimate build-out 25 MGD flow, the pumping station needs to be upgraded to discharge 10 MGD with a 25 MGD peak through the Potomac outfall, and a parallel outfall line would need to be added

Effluent/Reclaimed Water Pumping Station and Force Main Concept Plan

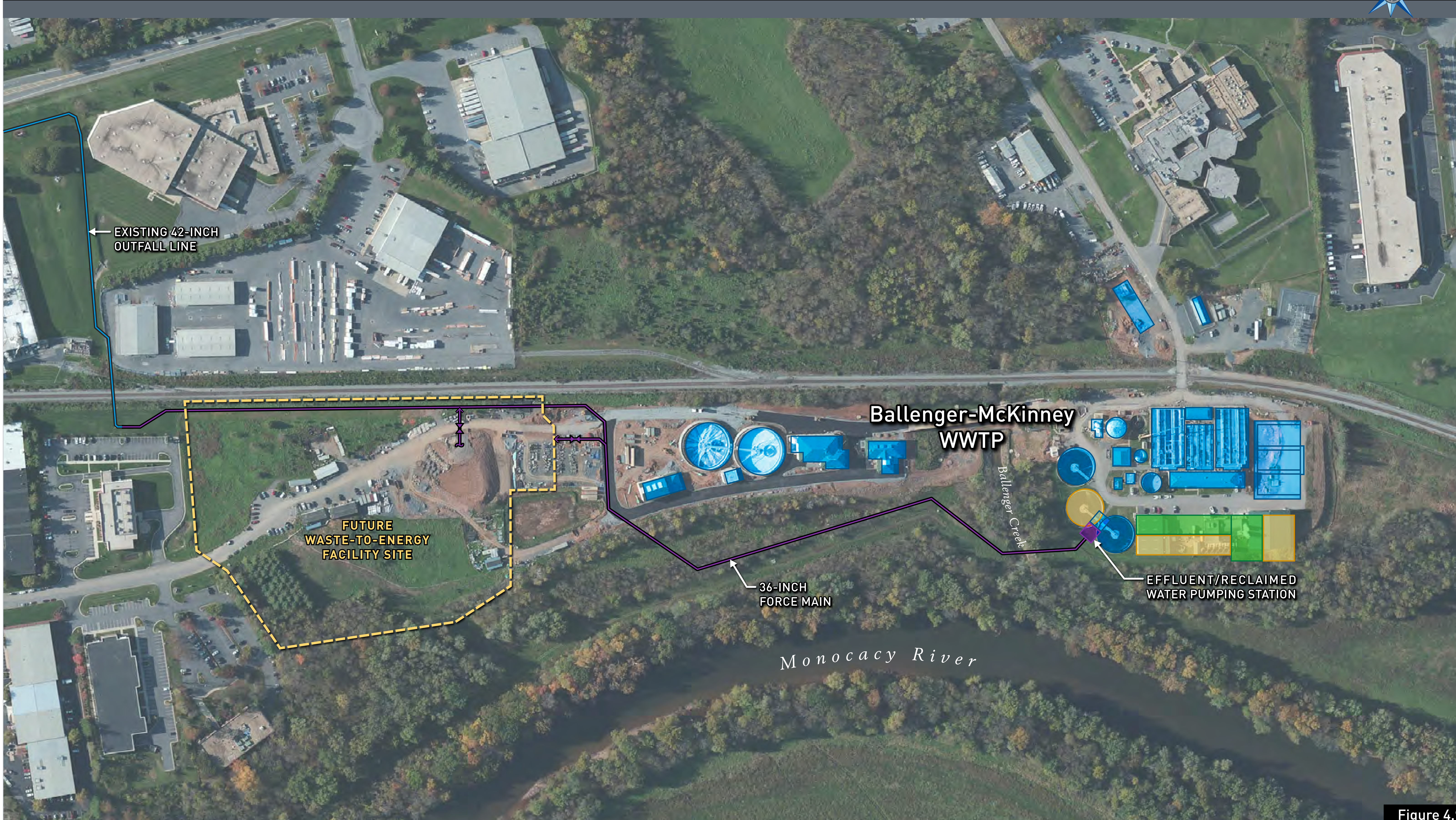

Figure 4.9

between English Muffin Way and Tuscarora Road to keep the discharge head within the design parameters discussed in the Phase I study. **Figure 4-10** illustrates the upgrade requirements to the Effluent Outfall line.

4.7 Cost Summary

Planning level costs have been developed for each of the infrastructure improvements discussed in the previous sections. Some improvements are assumed to be required, while others allow for alternatives that require cost evaluations.

4.7.1 Alternative Improvements Cost Evaluation

As discussed in Sections 4.4 and 4.5, several alternatives have been considered to improve the sewer capacity of the City Interceptor and Lower Monocacy Interceptors. **Table 4-2** summarizes capital costs for each option, with improvements to eliminate SSOs from the City Interceptor in each of the columns (as alternatives A, B, or C) and pumping station and force main alternatives to eliminate SSOs from the Lower Monocacy pressure sewer in each of the rows (alternatives 1 or 2). A single option using a combination of A, B, or C and 1 or 2 will be used to eliminate all SSOs within the system and will be presented as the lowest cost alternative as discussed below.

Table 4-2: Alternatives Cost Summary

		City Interceptor Improvement Alternatives		
Frederick County & City CIP Projects		**Alternative A:**	**Alternative B:**	**Alternative C:**
Lower Monocacy Interceptor Improvement Alternatives		**Parallel Sewer**	**Upsize Sewer**	**WTP PS**
Alternative 1: City WWTF Improvments	***Individual Cost***	**$3,220,000**	**$3,610,000**	**$10,660,000**
EQ Pump Station Upgrade Phase 1 (Includes Headworks Upgrade)	$26,280,000			
EQ Pump Station Phase 2	$6,110,000			
Airport Park PS Improvements	$570,000			
River Meadows PS Improvements	$790,000	**1A**	**1B**	**1C**
Alternative 1: City WWTF Improvements Total	**$33,750,000**	**$36,970,000**	**$37,360,000**	**$44,410,000**
Alternative 2: Carroll Creek Pumping Station and Force Main				
Carroll Creek Pumping Station and Force Main	$26,530,000	**2A**	**2B**	**2C**
Alternative 2: Carroll Creek Pumping Station and Force Main Total	**$26,530,000**	**$29,750,000**	**$30,140,000**	**$37,190,000**

Notes:
1. All costs are based on January 2013 dollars (ref. ENR cost index 9437.27)
2. Individual cost is sub-total or total of individual alternatives 1, 2 or 3 and A, B, or C.
3. Cost shown as 1A, 1B, and 1C are combinations of Alternative 1 and Alternatives A, B, and C.
4. Cost shown as 2A, 2B, and 2C are combinations of Alternative 2 and Alternatives A, B, and C.

4.7.2 Capital Improvements Plan Summary

For planning purposes, timing for capital improvements discussed herein is based on the SLAT. However, actual commencement of design and ultimately implementation of improvements will be based on flow triggers discussed in Section 4.2 and timing will be updated regularly based on feedback from the flow monitoring program.

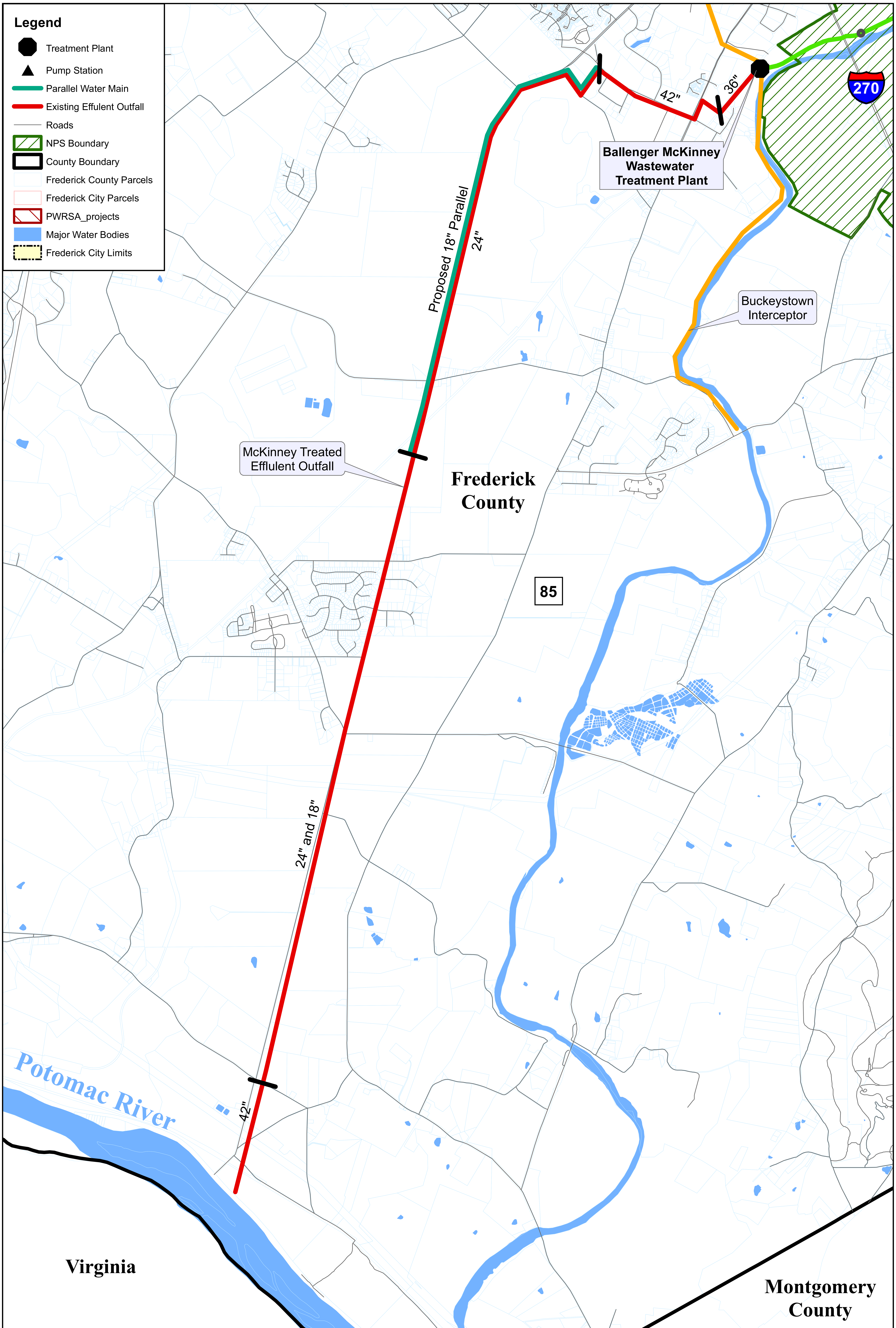

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Figure 4-10: Potomac River Effluent Outfall Plan

N

0 1,500 3,000 6,000 Feet

Table 4-3 provides a simplified summary of the cost and projected timing (based on the SLAT) of each capital improvements project associated with the lowest cost alternative. These costs represent planning level numbers and include the following general assumptions:

- The construction cost estimates are based on January 2013 dollars (Engineer News Record Construction Cost Index 9437.27)
- A 30% construction contingency was included for each separate cost.
- Project costs (engineering, administrative, etc.) have been assumed to equal 25% of the construction cost.
- Costs for mobilization/demobilization/bonds/insurance are assumed to be 5% of the material cost.

More specific cost summaries for each project are included in **Appendix C.**

Table 4-3: Capital Improvements Plan Cost Summary

Project Description	**Project Costs**		
Frederick County & City CIP Projects	**0-10 Years**	**11-20 Years**	**21+ Years**
General:			
Flow Metering Program - Installation	$170,000		
Upper Monocacy Interceptor:			
Ceresville PS Upgrade - Intermediate	$300,000		
Ceresville PS Upgrade - Final			$300,000
City Interceptor:			
City Interceptor Upgrade - Parallel Sewer at Carroll Creek	$240,000		
City Interceptor Upgrade - Parallel Sewer to MI-14		$3,220,000	
Lower Monocacy Interceptor:			
Carroll Creek Pumping Station and Force Main	$26,530,000		
Ballenger-McKinney WWTP:			
Expansion to 18 MGD		$53,910,000	
Expansion to 25 MGD			$51,360,000
Solids Handling Upgrades		$30,900,000	
Effluent Pumping Station and Force Main - 10 MGD		$12,810,000	
Effluent Pumping Station - 25 MGD Upgrade and Parallel Outfall			$16,570,000
SUB-TOTAL:	*$27,240,000*	*$100,840,000*	*$68,230,000*
TOTAL:			***$196,310,000***

Notes:

1. All costs are based on January 2013 dollars (ref. ENR cost index 9437.27)
2. Project timing is based on start of design necessary to have capacity available for SLAT timing. Partial funds for project completion may be divided across adjacent columns.
3. City Interceptor Parallel Sewer to MI-14 and Carroll Creek Pumping Station are lowest cost alternatives

5.0 Study Recommendations

5.1 Recommendations

This study has identified areas of the Monocacy Sewershed where there will be future capacity limitations and require additional infrastructure as previously described in Tables 4-2 and 4-3. This analysis has been based on available historical flow data, correspondence with County and City staff, planning forecasts and other assumptions as outlined herein. Recommendations for next steps include the following:

- Install reliable flow meters in locations in the County as indicated on Figure 4-1 and continue use of flow meters in the City for long term flow testing to verify the flow assumptions outlined herein. Long term flow metering will provide the County and City with an on-going tool to capture peak flow events, which will provide the ability to re-calibrate the Sewer Model, as necessary, and assess results of improvements being made to the system to combat infiltration and inflow. This will be important information in order to make decisions regarding the timing of infrastructure recommended in this report.

- Periodically analyze the flow metering data to confirm peaking factor assumptions. Initially, data should be analyzed after the first 3 years of flow measurements because of key infrastructure decisions that begin in the 6-10 year range. Thereafter, flow analysis and model updates could be every 5-10 years.

- Based on the flow data and projected CIP schedule, make determinations of the appropriate alternatives to pursue as infrastructure projects. For example, if the peaking factors are determined after the 3-year assessment to be less than or equal to the assumptions included in this study, the County and City may pursue upgrades to the EQ Pumping Station at the City WWTF, since it is unlikely the screening and grit removal processes at the City WWTF would have capacity limitations. However, should the peaking factors have been understated, an expansion of the screening, grit removal, and influent pumps would be required in the future in conjunction with the EQ Pumping Station option, making the Carroll Creek Pumping Station alternative a more desirable option. A similar approach should be taken to evaluate other infrastructure improvement alternatives recommended herein.

Appendix A

Sanitary Load Allocation Table

Contract	Manhole	Tax Map	Tax Grid	Name of Subdivision/Parcel	PRWSA #	Units	Ac./DU /CU/SF	Flow/ Unit	Existing Flow (gpd)	+Current	Currently Allocated Flow (gpd)	+2015	2015 Flow (gpd)	+2020	2020 Flow (gpd)	+2024	2024 Flow (gpd)	+2030	2030 Flow (gpd)	+2031	2031 Flow (gpd)	+2040	2040 Flow (gpd)	Comments
5-S	54			Glade Manor		247	DU	250	61,750		61,750		61,750		61,750		61,750		61,750		61,750		61,750	
5-S	54	852	23	1554		5.92	Ac.	1,000			0		0	1,954	1,954	781	2,735	1,172	3,907	195	4,103	1,758	5,861	Open Lot (4 DU/Ac.)
5-S	54			Sun Meadow		278	DU	250	63,000	4,000	67,000		67,000		67,000		67,000		67,000		67,000		67,000	252 Ex, 15 Vac, 1 Comm
5-S	54			Fountain Rock Meadow		225.2	DU	250	57,675	1,500	59,175		59,175		59,175		59,175		59,175		59,175		59,175	225.2 Ex, 11 Comm, 6 Vac Comm
5-S	54			Fountain Rock S		11.3	CU	250	1,413		1,413		1,413		1,413		1,413		1,413		1,413		1,413	
5-S	54			Heritage		28	DU	250	7,000		7,000		7,000		7,000		7,000		7,000		7,000		7,000	
5-S	54			Glade Towne		478	DU/CU	250	139,450		139,450		139,450		139,450		139,450		139,450		139,450		139,450	478 Ex, 159.6 Comm
5-S	54			Deerfield		285	DU/CU	250	72,138		72,138		72,138		72,138		72,138		72,138		72,138		72,138	285 Ex, 7.1 Comm
5-S	54	49	17	66		2.54	Ac.	1,000			0		0	838	838	335	1,173	503	1,676	84	1,760	754	2,515	Open Lot (4 DU/Ac.)
5-S	54	852	23	Walkers Brethren Church (2070)		5,104	SF	0.2	1,021		1,021		1,021		1,021		1,021		1,021		1,021		1,021	
5-S	54	851	0	Glade Valley Church (1724)		7,290	SF	0.2	1,458		1,458		1,458		1,458		1,458		1,458		1,458		1,458	
5-S	54	851	0	Walkers Village (1722)		86,231	SF	0.2	17,246		17,246		17,246		17,246		17,246		17,246		17,246		17,246	Market
5-S	54			Colony Village		161	DU/CU	250	46,725		46,725		46,725		46,725		46,725		46,725		46,725		46,725	161 Ex, 25.9 Comm
5-S	54	49	22	Walkers Village Center II (118)		27,838	SF	0.2		5,568	5,568		5,568		5,568		5,568		5,568		5,568		5,568	
5-S	54	851	22	Victoria Park (1552)		98.2	CU	250	12,025	500	12,525		12,525		12,525		12,525		12,525		12,525		12,525	96.2 Existing, 2 Vacant
5-S	54			Glade Elementary School		71,028	SF	0.2	14,206		14,206		14,206		14,206		14,206		14,206		14,206		14,206	
5-S	54			Winter Brook			DU/CU	250	25,500		25,500		25,500		25,500		25,500		25,500		25,500		25,500	65 Resid. 74 Comm.
5-S	54			Walkersville Residential		22	DU	250	5,500		5,500		5,500		5,500		5,500		5,500		5,500		5,500	
5-S	54			Walkersville Commercial		247.1	CU	250			0		0	20,386	20,386	8,154	28,540	12,231	40,772	2,039	42,810	18,347	61,157	
5-S	54	49		Town of Walkersville (922)		85.26	Ac.	1,400			0		0		0	47,746	47,746	71,618	119,364		119,364		119,364	
5-S	54	49		Town of Walkersville (144)		60	Ac.	1,400			0		0		0	33,600	33,600	50,400	84,000		84,000		84,000	
5-S	54	49		Commercial (13)		3.9	Ac.	1,400			0		0		0	2,184	2,184	3,276	5,460		5,460		5,460	
5-S	54	49		35		1	DU	250			0		0		0	100	100	150	250		250		250	S-5
5-S	54	49		36		1	DU	250			0		0		0	100	100	150	250		250		250	S-5
5-S	54	49		37		1	DU	250			0		0		0	100	100	150	250		250		250	S-5
5-S	54	49		17		1	DU	250			0		0		0	100	100	150	250		250		250	S-5
5-S	54			Manhole 54 (C: 5-S) Load					526,106	11,568	537,673	0	537,673	23,178	560,851	93,201	654,051	139,801	793,852	2,318	796,170	20,860	817,030	
5-S	53			Walkersville Residential		51	DU	250	12,750		12,750		12,750		12,750		12,750		12,750		12,750		12,750	
5-S	53			Manhole 53 (C:5-S) Load					12,750	0	12,750	0	12,750	0	12,750	0	12,750	0	12,750	0	12,750	0	12,750	
5-S	52	851	0	S & V Partnership (1466)		1.55	Ac.	1,400			0		0	716	716	286	1,003	430	1,432	72	1,504	644	2,148	
5-S	52	851	1	Lonza (1467)		29,402	SF	0.2	5,880		5,880		5,880		5,880		5,880		5,880		5,880		5,880	
5-S	52			Manhole 52 (C:5-S) Load					5,880	0	5,880	0	5,880	716	6,597	286	6,883	430	7,313	72	7,384	644	8,029	
5-S	49	49	21	Lonza (88)		20,552	SF	0.2	4,110		4,110		4,110		4,110		4,110		4,110		4,110		4,110	Industrial
5-S	49	850	3	Lonza (788)		259,206	SF	0.2	51,841		51,841		51,841		51,841		51,841		51,841		51,841		51,841	Office
5-S	49	49		Zimmerman, Agriculture (773)		29	Ac.	1,400			0		0		0	16,240	16,240	24,360	40,600		40,600		40,600	S-5
5-S	49	851		Agriculture (768)		25	Ac.	1,400			0		0		0	14,000	14,000	21,000	35,000		35,000		35,000	S-5
5-S	49	851		33		1	DU	250			0		0		0	100	100	150	250		250		250	S-5
5-S	49			32		1	DU	250			0		0		0	100	100	150	250		250		250	S-5
5-S	49			31		1	DU	250			0		0		0	100	100	150	250		250		250	S-5
5-S	49			44		1	DU	250			0		0		0	100	100	150	250		250		250	S-5
5-S	49			30		1	DU	250			0		0		0	100	100	150	250		250		250	S-5
5-S	49			29		1	DU	250			0		0		0	100	100	150	250		250		250	S-5
5-S	49			99		1	DU	250			0		0		0	100	100	150	250		250		250	S-5
5-S	49			100		1	DU	250			0		0		0	100	100	150	250		250		250	S-5
5-S	49			70		1	DU	250			0		0		0	100	100	150	250		250		250	S-5
5-S	49			23		1	DU	250			0		0		0	100	100	150	250		250		250	S-5
5-S	49			71		1	DU	250			0		0		0	100	100	150	250		250		250	S-5
5-S	49			22		1	DU	250			0		0		0	100	100	150	250		250		250	S-5
5-S	49			45		1	DU	250			0		0		0	100	100	150	250		250		250	S-5
5-S	49			60		1	DU	250			0		0		0	100	100	150	250		250		250	S-5
5-S	49			115		1	DU	250			0		0		0	100	100	150	250		250		250	S-5
5-S	49			Manhole 49 (C: 5-S) Load					55,952	0	55,952	0	55,952	0	55,952	31,740	87,692	47,610	135,302	0	135,302	0	135,302	
5-S	48	851	0	St. Paul's Evangelical Church (1458)		3,064	SF	0.2	613		613		613		613		613		613		613		613	
5-S	48			Walkersville Residential		65	DU	250	16,250		16,250		16,250		16,250		16,250		16,250		16,250		16,250	
5-S	48			Manhole 48 (C: 5-S) Load					16,863	0	16,863	0	16,863	0	16,863	0	16,863	0	16,863	0	16,863	0	16,863	
5-S	47			Walkersville Residential		269	DU	250	67,250		67,250		67,250		67,250		67,250		67,250		67,250		67,250	
5-S	47	850	23	Branch Banking and Trust (1101-1)		1,120	SF	0.2	224		224		224		224		224		224		224		224	
5-S	47	850	23	Frederick County Bank (1101-2)		2,349	SF	0.2	470		470		470		470		470		470		470		470	
5-S	47	850	23	PNC Bank (1101-3)		1,470	SF	0.2	294		294		294		294		294		294		294		294	
5-S	47	850	15	1096		2,445	SF	0.2	489		489		489		489		489		489		489		489	Library
5-S	47	58	3	Moxley Property (302-1)		5,307	SF	0.2	1,061		1,061		1,061		1,061		1,061		1,061		1,061		1,061	
5-S	47	851	0	Walkersville Elementary School (1102)		27,352	SF	0.2	5,470		5,470		5,470		5,470		5,470		5,470		5,470		5,470	
5-S	47	850	15	Walkersville Middle School (1097)		102,777	SF	0.2	20,555		20,555		20,555		20,555		20,555		20,555		20,555		20,555	
5-S	47	851	0	Walkersville United Methodist Church (1396)		12,032	SF	0.2	2,406		2,406		2,406		2,406		2,406		2,406		2,406		2,406	

Sanitary Load Allocation Table

Contract	Manhole	Tax Map	Tax Grid	Name of Subdivision/Parcel	PRWSA #	Units	Ac./DU /CU/SF	Flow/ Unit	Existing Flow (gpd)	+Current	Currently Allocated Flow (gpd)	+2015	2015 Flow (gpd)	+2020	2020 Flow (gpd)	+2024	2024 Flow (gpd)	+2030	2030 Flow (gpd)	+2031	2031 Flow (gpd)	+2040	2040 Flow (gpd)	Comments
5-S	47	851	0	St. Paul's Evangelical Lutheran Church (1434)		10,337	SF	0.2	2,067		2,067		2,067		2,067		2,067		2,067		2,067		2,067	
5-S	47	58	3	RE AHC (281)		50,840	SF	0.2	10,168		10,168		10,168		10,168		10,168		10,168		10,168		10,168	Nursing Home
5-S	47			Manhole 47 (C: 5-S) Load					110,456	0	110,456	0	110,456	0	110,456	0	110,456	0	110,456	0	110,456	0	110,456	
5-S	44	58	2	Walkersville High School		191,104	SF	0.2	38,221		38,221		38,221		38,221		38,221		38,221		38,221		38,221	
5-S	44	58	3	Walkersville Volunteer Fire Co.		38,342	SF	0.2	7,668		7,668		7,668		7,668		7,668		7,668		7,668		7,668	
5-S	44	851	9	St. Timothy Roman Catholic Congregation		21,081	SF	0.2	4,216		4,216		4,216		4,216		4,216		4,216		4,216		4,216	
5-S	44	851	9	Westview		23	DU	250	8,388		8,388		8,388		8,388		8,388		8,388		8,388		8,388	23 Ex, 21.1 Comm
5-S	44			Spring Garden		66	DU	250	16,750		16,750		16,750		16,750		16,750		16,750		16,750		16,750	66 Ex, 1 Vac
5-S	44			Walkersville Residential		89	DU	250	22,250		22,250		22,250		22,250		22,250		22,250		22,250		22,250	
5-S	44			Manhole 44 (C: 5-S) Load					97,493	0	97,493	0	97,493	0	97,493	0	97,493	0	97,493	0	97,493	0	97,493	
213E-S	40A	58	2	Creekside Park		21	DU	250	5,250		5,250		5,250		5,250		5,250		5,250		5,250		5,250	
213E-S	40A			Fredericktowne Baptist Church		30,187	SF	0.2	6,037		6,037		6,037		6,037		6,037		6,037		6,037		6,037	
213E-S	40A			Manhole 40A (C: 213E-S) Load					11,287	0	11,287	0	11,287	0	11,287	0	11,287	0	11,287	0	11,287	0	11,287	
5-S	38	58	2	59		6	DU	250	1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500	
5-S	38	58	2	96		1	Du	250	250		250		250		250		250		250		250		250	
5-S	38	58	2	97		1	DU	250	250		250		250		250		250		250		250		250	
5-S	38	58	2	98		1	DU	250	250		250		250		250		250		250		250		250	
5-S	38	58	2	225		1	DU	250	250		250		250		250		250		250		250		250	
5-S	38	58	2	227		1	DU	250	250		250		250		250		250		250		250		250	
5-S	38			Manhole 38 (C: 5-S) Load					2,750	0	2,750	0	2,750	0	2,750	0	2,750	0	2,750	0	2,750	0	2,750	
213A-S	2	58	2	Creekside Park		58	DU	250	14,500		14,500		14,500		14,500		14,500		14,500		14,500		14,500	
213A-S	2	58	2	BOCC (59)		0.25	Ac.	1,400			0		0		0	140	140	210	350		350		350	S-5
213A-S	2	58	2	Agriculture (60)		12.59	Ac.	1,400			0		0	17,626	17,626		17,626		17,626		17,626		17,626	S-4
213A-S	2	58	2	Agriculture (245)		72.5	Ac.	1,400			0		0	101,500	101,500		101,500		101,500		101,500		101,500	S-4
213A-S	2			Manhole 2 (C: 213A-S) Load					14,500	0	14,500	0	14,500	119,126	133,626	140	133,766	210	133,976	0	133,976	0	133,976	
4-S	32			Dublin Manor		32	DU	250	8,000		8,000		8,000		8,000		8,000		8,000		8,000		8,000	
4-S	32			Agriculture (58)		89.1	Ac.	1,400			0		0		0		0		0	12,474	12,474	112,266	124,740	08PS
4-S	32			Manhole 32 (C: 4-S) Load					8,000	0	8,000	0	8,000	0	8,000	0	8,000	0	8,000	12,474	20,474	112,266	132,740	
2-S	14	57		Industrial (74)		28.93	Ac.	1,400	10,126		10,126		10,126	10,126	20,251	4,050	24,301	6,075	30,377	1,013	31,389	9,113	40,502	
2-S	14	57		Century (325)		182.68	Ac.	1,400			0	63,938	63,938	63,938	127,876	25,575	153,451	38,363	191,814	6,394	198,208	57,544	255,752	
2-S	14	58	9	Peace in Christ Church		8,448	SF	0.2	1,690		1,690		1,690		1,690		1,690		1,690		1,690		1,690	
2-S	14			Discovery Crossings		164	CU	250	20,275	500	20,775		20,775		20,775		20,775		20,775		20,775		20,775	162 Ex Comm, 2 Vac
2-S	14			Discovery		655	DU	175/250	133,750		133,750		133,750		133,750		133,750		133,750		133,750		133,750	
2-S	14	58		Industrial (PO. 288)		3.97	Ac.	1,400			0		0		0	2,223	2,223	3,335	5,558		5,558		5,558	S-5
2-S	14	58		71		10	Ac.	1,400			0		0		0		0		0	1,400	1,400	12,600	14,000	08PS
2-S	14			Manhole 14 (C: 2-S) Load					165,840	500	166,340	63,938	230,278	74,064	304,342	31,849	336,190	47,773	383,963	8,806	392,769	79,257	472,027	
				Walkersville					1,027,877	12,068	1,039,944	63,938	1,103,882	217,083	1,320,965	157,216	1,478,181	235,823	1,714,005	23,670	1,737,674	213,027	1,950,702	
226B-S	1			Meadowbrook		12.2	Ac.	1400			0		0	17,080	17,080		17,080		17,080		17,080		17,080	Assumed Planned Mid-Range
226B-S	1			Bartgis	9	144	DU	250			0	10,000	10,000	26,000	36,000	0	36,000	0	36,000		36,000		36,000	redistributed
226B-S	1			Rice	10	111	DU	250			0		0		0	11,100	11,100	16,650	27,750		27,750		27,750	
226B-S	1			Rothenhoefer	11	33	DU	250			0		0	8,250	8,250	0	8,250	0	8,250		8,250		8,250	redistributed
226B-S	1			Desando	12	12	DU	250			0				0	1,200	1,200	1,800	3,000		3,000		3,000	redistributed
226B-S	1			Cannon Bluff	13	187	DU	250	15,500		15,500	31,250	46,750		46,750		46,750		46,750		46,750		46,750	
226B-S	1			Keller - North	14A	160	DU	250			0	8,000	8,000	8,000	16,000	24,000	40,000	0	40,000		40,000		40,000	redistributed
226B-S	1			Keller - East	14B	131	DU	250			0	6,550	6,550	6,550	13,100	19,650	32,750	0	32,750		32,750		32,750	redistributed
226B-S	1			Keller - South	14C	327	DU	250			0	16,350	16,350	16,350	32,700	49,050	81,750	0	81,750		81,750		81,750	redistributed
226B-S	1			Staley	15	216	DU	250			0	10,800	10,800	10,800	21,600	32,400	54,000	0	54,000		54,000		54,000	redistributed
226B-S	1			Clover Ridge, LLC - North	16A	93	Du	250			0		0		0	9,300	9,300	13,950	23,250		23,250		23,250	
226B-S	1			Hooper - Northeast	17A	186	DU	250			0		0		0	18,600	18,600	27,900	46,500		46,500		46,500	
226B-S	1			Tuscacora Creek	54	847	DU	250/225 /175		71,000	71,000	123,325	194,325		194,325		194,325		194,325		194,325		194,325	528 @ 250 gpd, 130 @ 225 gpd, 189 @ 175 gpd
226B-S	1			Crum, Staley, Willowbrook	62	134	DU	250			0		0		0	13,400	13,400	20,100	33,500		33,500		33,500	
226B-S	1			Manhole 1 (C: 226B-S) Load					15,500	71,000	86,500	206,275	292,775	93,030	385,805	165,300	551,105	60,300	611,405	0	611,405	0	611,405	
195-S	109	57	15	218		1,984	SF	0.2	397		397		397		397		397		397		397		397	Sports Field and Facility
195-S	109	57	19	228		1	DU	250	250		250		250		250		250		250		250		250	
195-S	109	57	14	Carbaugh Addition		10.2	Ac.	1400			0	14,280	14,280		14,280		14,280		14,280		14,280		14,280	Assumed Planned Immediate
195-S	109	57	20	24		1	DU	250	250		250		250		250		250		250		250		250	
195-S	109			Clover Hill III		330	DU	250	82,250	250	82,500		82,500		82,500		82,500		82,500		82,500		82,500	Portion of Clover Hill
195-S	109			Sunset Drive		43	DU	250			0		0		0	4,300	4,300	6,450	10,750		10,750		10,750	
195-S	109			West Hills		75	DU	250			0		0		0	7,500	7,500	11,250	18,750		18,750		18,750	
195-S	109			Clover Ridge, Garst	7	308	DU	250	61,000	8,500	69,500		69,500		69,500		69,500		69,500		69,500		69,500	214 Ex, 33 Vac, 60 Comm, 1 Vac Comm
195-S	109			Sanner	8	192	DU	250			0	10,000	10,000	10,000	20,000	28,000	48,000	0	48,000		48,000		48,000	school, fire stat. 2015 ? Redistributed
195-S	109			Tauraso Annex.	105	13.5	Ac.	1000			0		0		0	5,400	5,400	8,100	13,500		13,500		13,500	
195-S	109			Manhole 109 (C: 195-S) Load					144,147	8,750	152,897	24,280	177,177	10,000	187,177	45,200	232,377	25,800	258,177	0	258,177	0	258,177	
185-S	14			Willowbrook	55	402	DU	175/250	81,750		81,750		81,750		81,750		81,750		81,750		81,750		81,750	

Sanitary Load Allocation Table

Contract	Manhole	Tax Map	Tax Grid	Name of Subdivision/Parcel	PRWSA #	Units	Ac./DU /CU/SF	Flow/ Unit	Existing Flow (gpd)	+Current	Currently Allocated Flow (gpd)	+2015	2015 Flow (gpd)	+2020	2020 Flow (gpd)	+2024	2024 Flow (gpd)	+2030	2030 Flow (gpd)	+2031	2031 Flow (gpd)	+2040	2040 Flow (gpd)	Comments
185-S	14			Manhole 14 (C: 185-S) Load					81,750	0	81,750	0	81,750	0	81,750	0	81,750	0	81,750	0	81,750	0	81,750	
221-S	9	57	10	Homewood Retirement Center (310)		97,803	SF	0.2	19,561		19,561		19,561		19,561		19,561		19,561		19,561		19,561	Assume 0.2 gpd/SF
221-S	9	57	10	Homewood (Crum Farm Lot) (29)		11	Ac.	900			0	9,900	9,900		9,900		9,900		9,900		9,900		9,900	
221-S	9			Manhole 9 (C: 221-S) Load					19,561	0	19,561	9,900	29,461	0	29,461	0	29,461	0	29,461	0	29,461	0	29,461	
8-S	27	57	16	72		1	DU	250	250		250		250		250		250		250		250		250	
8-S	27	57	16	209-16		19,340	SF	0.2	3,868		3,868		3,868		3,868		3,868		3,868		3,868		3,868	
8-S	27	57	16	209-17		18,620	SF	0.2	3,724		3,724		3,724		3,724		3,724		3,724		3,724		3,724	
8-S	27	401	3	1441		1	DU	250	250		250		250		250		250		250		250		250	
8-S	27	401	0	1-1		1	DU	250	250		250		250		250		250		250		250		250	
8-S	27	401	0	1-2		1	DU	250	250		250		250		250		250		250		250		250	
8-S	27	57	16	Maranatha Church		48,895	SF	0.1	4,890		4,890		4,890		4,890		4,890		4,890		4,890		4,890	
8-S	27	401	0	Monocacy Elementary School		58,300	SF	0.2	11,660		11,660		11,660		11,660		11,660		11,660		11,660		11,660	
8-S	27	401	0	Monocacy Middle School		111,993	SF	0.2	22,399		22,399		22,399		22,399		22,399		22,399		22,399		22,399	
8-S	27	401	0	Frederick Co. Voc. Tech Center		84,304	SF	0.15	12,646		12,646		12,646		12,646		12,646		12,646		12,646		12,646	
8-S	27	401	0	Frederick Community College		265,861	SF	0.15	39,879		39,879		39,879		39,879		39,879		39,879		39,879		39,879	
8-S	27	57	16	Arrowhead		22	DU	250	5,500		5,500		5,500		5,500		5,500		5,500		5,500		5,500	
8-S	27	57		Clover Hill I & II		525	DU	250	131,250		131,250		131,250		131,250		131,250		131,250		131,250		131,250	Only a portion of Clover Hill
8-S	27	57	15	Cloverview		10	DU	250	2,500		2,500		2,500		2,500		2,500		2,500		2,500		2,500	
8-S	27			Crumland Farm Annex.	1	285	Ac.				0		0	200,000	200,000	102,000	302,000	153,000	455,000		455,000		455,000	Flows based on City Analysis
8-S	27			COPT/Thatcher Annex.	2	151	Ac.	1400			0		0	211,400	211,400		211,400		211,400		211,400		211,400	
8-S	27			Ritchfield Farm Annex.	3	139	Ac.	1400			0		0		0	77,840	77,840	116,760	194,600		194,600		194,600	
8-S	27			Nathan	4	96	Ac.	1400			0		0	67,200	67,200	26,880	94,080	40,320	134,400		134,400		134,400	
8-S	27			Homewood	5	500	DU	200			0	20,000	20,000	50,000	70,000	30,000	100,000	0	100,000		100,000		100,000	revised units, redistributed
8-S	27			North Crossing	6	487	DU/CU	175/250	100,838		100,838		100,838		100,838		100,838		100,838		100,838		100,838	
8-S	27			San Miguel - Gateway	47	490,050	SF	0.2			0		0	98,010	98,010		98,010		98,010		98,010		98,010	
8-S	27			Governor's Choice	52	139.8	CU	250	16,475		16,475		16,475	2,000	18,475		18,475		18,475		18,475		18,475	131.8 Ex Comm, 8 Vac Comm
8-S	27			Beckley Store/Motel	113						0		0		0	800	800	1,200	2,000		2,000		2,000	
8-S	27			Manhole 27 (C: 8-S) Load					356,627	0	356,627	20,000	376,627	628,610	1,005,237	237,520	1,242,757	311,280	1,554,037	0	1,554,037	0	1,554,037	
8-S	13	57	17	State Farm (39)		383,394	SF	0.1	38,339		38,339		38,339		38,339		38,339		38,339		38,339		38,339	Assume 0.2 gpd/SF reduced unit rate
8-S	13			Tuscarora Knolls		335	DU	225	75,375		75,375		75,375		75,375		75,375		75,375		75,375		75,375	163 Ex Comm
8-S	13			Manhole 13 (C: 8-S) Load					113,714	0	113,714	0	113,714	0	113,714	0	113,714	0	113,714	0	113,714	0	113,714	
221A-S	1			Wormans Mill	57				94,772	19,500	114,272	68,100	182,372	46,250	228,622		228,622		228,622		228,622		228,622	206 @ 225 gpd, 1023 @ 175 gpd, 108.7 Comm, 7 Vac Comm reduced
221A-S	1			Manhole 1 (C: 221A-S) Load					94,772	19,500	114,272	68,100	182,372	46,250	228,622	0	228,622	0	228,622	0	228,622	0	228,622	
8-S	9			State Farm	38	21	Ac.	1,400			0		0	29,400	29,400		29,400		29,400		29,400		29,400	May need to drain South OK in north
8-S	9			Manhole 9 (C: 8-S) Load					0	0	0	0	0	29,400	29,400	0	29,400	0	29,400	0	29,400	0	29,400	
8-S	1			Wormald Annex.	104						0		0		0		0		0		0		0	No Annexation Request ok
8-S	1			Manhole 1 (C: 8-S) Load					0	0	0		0		0	0	0	0	0	0	0	0	0	
				Tuscarora Interceptor					826,071	99,250	925,321	328,555	1,253,876	807,290	2,061,166	448,020	2,509,186	397,380	2,906,566	0	2,906,566	0	2,906,566	
2-S	9	58	19	106		1	DU	250			0		0		0	100	100	150	250		250		250	
2-S	9	58	19	203		3.6	Ac	1400			0		0		0	2,016	2,016	3,024	5,040		5,040		5,040	
2-S	9	58	19	224		1.3	Ac	1,400			0		0		0	728	728	1,092	1,820		1,820		1,820	
2-S	9	58	19	Waterside		201	DU	225	45,225		45,225		45,225		45,225		45,225		45,225		45,225		45,225	
2-S	9			Manhole 9 (C: 2-S) Load					45,225	0	45,225	0	45,225	0	45,225	2,844	48,069	4,266	52,335	0	52,335	0	52,335	
2-S	7			CeresVille PS Discharge					1,899,173	111,318	2,010,490	392,493	2,402,983	1,024,373	3,427,356	608,080	4,035,436	637,469	4,672,906	23,670	4,696,575	213,027	4,909,603	
2-S	7			Manhole 7 (C: 2-S) Load					1,899,173	111,318	2,010,490	392,493	2,402,983	1,024,373	3,427,356	608,080	4,035,436	637,469	4,672,906	23,670	4,696,575	213,027	4,909,603	
2-S	6			Dearbought	36	773	DU/CU	225	132,609	17,800	150,409		150,409		150,409		150,409		150,409		150,409		150,409	695 Ex, 78 Vac, 163.5 Comm, 1 Vac Comm reduced
2-S	6			Manhole 6 (C: 2-S) Load					132,609	17,800	150,409	0	150,409	0	150,409	0	150,409	0	150,409	0	150,409	0	150,409	
2-S	3			Main (Rt. 26), Monocacy Park	43	282	DU	175	18,375	23,975	42,350	7,000	49,350		49,350		49,350		49,350		49,350		49,350	
2-S	3	58	19	Waterside		351	DU	225	84,288	225	84,513		84,513		84,513		84,513		84,513		84,513		84,513	350 Ex, 1 Vac, 44.3 Comm
2-S	3	57	24	108		3.6	Ac	1,400			0		0		0	2,016	2,016	3,024	5,040		5,040		5,040	
2-S	3	57	24	114		1.5	Ac	1,400			0		0		0	840	840	1,260	2,100		2,100		2,100	
2-S	3	57	24	128		1	DU	250			0		0		0	100	100	150	250		250		250	
2-S	3	57	24	129		1	DU	250			0		0		0	100	100	150	250		250		250	
2-S	3	57	24	130		2	DU	250			0		0		0	200	200	300	500		500		500	
2-S	3	57	24	144		1	DU	250			0		0		0	100	100	150	250		250		250	
2-S	3	57	24	149		1	DU	250			0		0		0	100	100	150	250		250		250	
2-S	3	57	24	150		1	DU	250			0		0		0	100	100	150	250		250		250	
2-S	3	57	24	141		1	DU	250			0		0		0	100	100	150	250		250		250	
2-S	3	57	24	152		1	DU	250			0		0		0	100	100	150	250		250		250	
2-S	3	57	24	153		1	DU	250			0		0		0	100	100	150	250		250		250	
2-S	3	57	24	170		1	DU	250			0		0		0	100	100	150	250		250		250	
2-S	3	57	24	184		1	DU	250			0		0		0	100	100	150	250		250		250	
2-S	3	57	24	186		1	DU	250			0		0		0	100	100	150	250		250		250	
2-S	3	57	24	187		1	DU	250			0		0		0	100	100	150	250		250		250	

Sanitary Load Allocation Table

Contract	Manhole	Tax Map	Tax Grid	Name of Subdivision/Parcel	PRWSA #	Units	Ac./DU /CU/SF	Flow/ Unit	Existing Flow (gpd)	+Current	Currently Allocated Flow (gpd)	+2015	2015 Flow (gpd)	+2020	2020 Flow (gpd)	+2024	2024 Flow (gpd)	+2030	2030 Flow (gpd)	+2031	2031 Flow (gpd)	+2040	2040 Flow (gpd)	Comments
2-S	3	57	24	188		1	DU	250			0		0		0	100	100	150	250		250		250	
2-S	3	57	24	189		1	DU	250			0		0		0	100	100	150	250		250		250	
2-S	3	57	24	190		1	DU	250			0		0		0	100	100	150	250		250		250	
2-S	3	57	24	191		1	DU	250			0		0		0	100	100	150	250		250		250	
2-S	3	57	24	206		1	DU	250			0		0		0	100	100	150	250		250		250	
2-S	3	57	24	229		1	DU	250			0		0		0	100	100	150	250		250		250	
2-S	3	57	24	247		1	DU	250			0		0		0	100	100	150	250		250		250	
2-S	3	57	24	Broadview		30	DU	250			0		0		0	3,000	3,000	4,500	7,500		7,500		7,500	
2-S	3			Manhole 3 (C: 2-S) Load					102,663	24,200	126,863	7,000	133,863	0	133,863	7,956	141,819	11,934	153,753	0	153,753	0	153,753	
139AS	1	405	4	Riverview		0	AC.		0		0		0		0		0		0		0		0	Stormwater pond and recreational fields (from Aerial) =Lake Ed
139AS	1			Riverside Center	44	281.7	CU	200	28,170		28,170		28,170		28,170		28,170		28,170		28,170		28,170	reduced
8-S	9	57	24	CVS (132-1)		10,107	SF	0.1	1,011		1,011		1,011		1,011		1,011		1,011		1,011		1,011	reduced rate
8-S	9	57	24	Auto Zone (132-2)		5,400	SF	0.15	810		810		810		810		810		810		810		810	reduced rate
8-S	9	57	24	Glade Valley Animal Hospital (132-3)		5,496	SF	0.15	824		824		824		824		824		824		824		824	reduced rate
8-S	9	423	22	SME Fred. Trade LLC (1)		205,492	SF	0.2	10,275	30,824	41,098		41,098		41,098		41,098		41,098		41,098		41,098	WALMART proposed redistributed
8-S	9			Lee Annex.	103	12	Ac.	1400			0		0		0	6,720	6,720	10,080	16,800		16,800		16,800	May need to drain South OK in north
139AS	1			Manhole 1 (C: 139AS) Load					41,090	30,824	71,914	0	71,914	0	71,914	6,720	78,634	10,080	88,714	0	88,714	0	88,714	
				Upstream of the Parshall Flume					276,362	72,824	349,185	7,000	356,185	0	356,185	14,676	370,861	22,014	392,875	0	392,875	0	392,875	Does not include Ceresville Flows
				Upper Monocacy Flow					2,175,534	184,141	2,359,676	399,493	2,759,169	1,024,373	3,783,542	622,756	4,406,297	659,483	5,065,781	23,670	5,089,451	213,027	5,302,478	All County flow within the City Interceptor
67-F	MI-23			Frederick Water Treatment Plant					108,000		108,000		108,000	0	108,000		108,000		108,000		108,000		108,000	The plant backwashes 108,000 gal once in a day and will be converted to a pumped flow of 250 gpm
67-F	MI-23			Manhole MI-23 (C: 67-F) Load					108,000	0	108,000	0	108,000	0	108,000	0	108,000	0	108,000	0	108,000	0	108,000	
67-F	MI-22			Fort Detrick Water Treatment Plant							0	88,000	88,000	0	88,000		88,000		88,000		88,000		88,000	
67-F	MI-22			Manhole MI-22 (C: 67-F) Load					0	0	0	88,000	88,000	0	88,000	0	88,000	0	88,000	0	88,000	0	88,000	
67-F	MI-19			Wormans Mill Industrial Park					25,000		25,000		25,000	0	25,000		25,000		25,000		25,000		25,000	reduced
67-F	MI-19			Market Square	37	1		135110	5,000	30,000	35,000	100,110	135,110	0	135,110		135,110		135,110		135,110		135,110	redistributed
67-F	MI-19			Clemson	101	375,000	SF	0.2	40,000	0	40,000		40,000	0	40,000		40,000		40,000		40,000		40,000	reduced to ex flows
67-F	MI-19			Spring Bank Annex.	102	72	DU	250			0	4,500	4,500	13,500	18,000	0	18,000	0	18,000		18,000		18,000	redistributed
67-F	MI-19			Manhole MI-19 (C: 67-F) Load					70,000	30,000	100,000	104,610	204,610	13,500	218,110	0	218,110	0	218,110	0	218,110	0	218,110	
67-F	MI-18	405	13	Auto Show Room (1168)		11,380	SF	0.2	2,276		2,276		2,276	0	2,276		2,276		2,276		2,276		2,276	
67-F	MI-18			Manhole MI-18 (C: 67-F) Load					2,276	0	2,276	0	2,276	0	2,276	0	2,276	0	2,276	0	2,276	0	2,276	
67-F	MI-17			Amber Meadows		856	DU	225	192,600		192,600		192,600	0	192,600		192,600		192,600		192,600		192,600	TH units
67-F	MI-17			Frederick Research Park					164,110		164,110		164,110	0	164,110		164,110		164,110		164,110		164,110	
67-F	MI-17			Heather Ridge		261	DU	225	58,725		58,725		58,725	0	58,725		58,725		58,725		58,725		58,725	TH units
67-F	MI-17			Amber Meadows Business Park					49,540		49,540		49,540	0	49,540		49,540		49,540		49,540		49,540	
67-F	MI-17			Antietam Village					40,000		40,000		40,000	0	40,000		40,000		40,000		40,000		40,000	reduced
67-F	MI-17			Rosehill Plaza					18,103		18,103		18,103	0	18,103		18,103		18,103		18,103		18,103	
67-F	MI-17	67	10	Frederick Alliance Church (57)		6,828	SF	0.2	1,366		1,366		1,366	0	1,366		1,366		1,366		1,366		1,366	
67-F	MI-17	404	17	Heather Ridge Elementary School (1009)		30,000	SF	0.2	6,000		6,000		6,000	0	6,000		6,000		6,000		6,000		6,000	
67-F	MI-17			Wormans Mill Industrial Park					20,000		20,000		20,000	0	20,000		20,000		20,000		20,000		20,000	reduced
67-F	MI-17			Manhole MI-17 (C: 67-F) Load					550,443	0	550,443	0	550,443	0	550,443	0	550,443	0	550,443	0	550,443	0	550,443	
67-F	MI-14			Fredericktowne Village		34	DU	225	7,650		7,650		7,650	0	7,650		7,650		7,650		7,650		7,650	TH units
67-F	MI-14			Manhole MI-14 (C: 67-F) Load					7,650	0	7,650	0	7,650	0	7,650	0	7,650	0	7,650	0	7,650	0	7,650	
67-F	MI-13			Fredericktowne Village		20	DU	225	4,500		4,500		4,500	0	4,500		4,500		4,500		4,500		4,500	TH units
67-F	MI-13			Manhole MI-13 (C: 67-F) Load					4,500	0	4,500	0	4,500	0	4,500	0	4,500	0	4,500	0	4,500	0	4,500	
67-F	MI-12			Fredericktowne Village		70	DU	225	15,750		15,750		15,750	0	15,750		15,750		15,750		15,750		15,750	TH units
67-F	MI-12			Manhole MI-12 (C: 67-F) Load					15,750	0	15,750	0	15,750	0	15,750	0	15,750	0	15,750	0	15,750	0	15,750	
67-F	MI-10			Fredericktowne Village		802	DU	225	180,450		180,450		180,450	0	180,450		180,450		180,450		180,450		180,450	TH units
67-F	MI-10			Canterbury Station	202	359	DU			74,275	74,275	23,800	98,075	0	98,075		98,075		98,075		98,075		98,075	
67-F	MI-10	405	4	Canterbury Station (1169-1)		27,645	SF	0.2	5,529		5,529		5,529	0	5,529		5,529		5,529		5,529		5,529	Nursing Home
67-F	MI-10			Manhole MI-10 (C: 67-F) Load					185,979	74,275	260,254	23,800	284,054	0	284,054	0	284,054	0	284,054	0	284,054	0	284,054	
67-F	MI-5			Riverside Corporate Park	48	440	Ac.		11,500	65,000	76,500	23,850	100,350	113,300	213,650		213,650		213,650		213,650		213,650	
67-F	MI-5			Riverside Apartments	205	312	DU	175	38,500	16,100	54,600		54,600	41,750	96,350		96,350		96,350		96,350		96,350	
67-F	MI-5			Manhole MI-5 (C: 67-F) Load					50,000	81,100	131,100	23,850	154,950	155,050	310,000	0	310,000	0	310,000	0	310,000	0	310,000	All City Growth East of Monocacy
				Monocacy Interceptor City Load					994,598	185,375	1,179,973	240,260	1,420,233	168,550	1,588,783	0	1,588,783	0	1,588,783	0	1,588,783	0	1,588,783	
33" Int.	MI-1			Nicodemus	35	457	DU				0	57,125	57,125	41,050	98,175		98,175		98,175		98,175		98,175	redistributed
33" Int.	MI-1			River Crest	45	114	DU	250	26,750	1,750	28,500		28,500		28,500		28,500		28,500		28,500		28,500	
33" Int.	MI-1			Schley	46	124	Ac.	1,400			0		0	173,600	173,600		173,600		173,600		173,600		173,600	
33" Int.	MI-1			Umberger	51	125	Ac.	1,400			0		0		0	70,000	70,000	105,000	175,000		175,000		175,000	
33" Int.	MI-1			City Infill Dev.	59	60	Ac.	1,400	14,000		14,000	17,500	31,500	52,500	84,000		84,000		84,000		84,000		84,000	
33" Int.	MI-1			Central Frederick					784,250		784,250		784,250		784,250		784,250		784,250		784,250		784,250	match average meter readings - line below
33" Int.	MI-1			33" Gas House Pike Interceptor Load					825,000	1,750	826,750	74,625	901,375	267,150	1,168,525	70,000	1,238,525	105,000	1,343,525	0	1,343,525	0	1,343,525	
54" Int.	1500			Clover Ridge, LLC - South	16B	93	DU	250			0		0		0	9,300	9,300	13,950	23,250		23,250		23,250	
54" Int.	1500			Hooper - Southwest	17B	186	DU	250			0		0		0	18,600	18,600	27,900	46,500		46,500		46,500	

Sanitary Load Allocation Table

Contract	Manhole	Tax Map	Tax Grid	Name of Subdivision/Parcel	PRWSA #	Units	Ac./DU /CU/SF	Flow/ Unit	Existing Flow (gpd)	+Current	Currently Allocated Flow (gpd)	+2015	2015 Flow (gpd)	+2020	2020 Flow (gpd)	+2024	2024 Flow (gpd)	+2030	2030 Flow (gpd)	+2031	2031 Flow (gpd)	+2040	2040 Flow (gpd)	Comments
54" Int.	1500			Barrick	18A	301	DU	250		11,250	11,250	53,075	64,325		64,325		64,325		64,325		64,325		64,325	
54" Int.	1500			Millie's Delight	18B	59	DU	250		9,500	9,500	5,250	14,750		14,750		14,750		14,750		14,750		14,750	
54" Int.	1500			Oden	19	240	DU	250			0	5,000	5,000	30,000	35,000	25,000	60,000	0	60,000		60,000		60,000	redistributed
54" Int.	1500			Lake Coventry	20	40	DU	250	10,000		10,000		10,000		10,000		10,000		10,000		10,000		10,000	
54" Int.	1500			Commons of Avalon	21	66	DU	225		9,675	9,675	5,175	14,850		14,850		14,850		14,850		14,850		14,850	
54" Int.	1500			Blentinger Road Property	22	84	DU	250			0		0		0	8,400	8,400	12,600	21,000		21,000		21,000	
54" Int.	1500			Birdseye View Estates	23	39	DU	250		9,750	9,750		9,750		9,750		9,750		9,750		9,750		9,750	
54" Int.	1500			Dutrow	24	45,738	SF	0.2			0		0		0	3,659	3,659	5,489	9,148		9,148		9,148	
54" Int.	1500			VFW	25	180	DU	250			0		0	18,000	18,000	27,000	45,000	0	45,000		45,000		45,000	redistributed
54" Int.	1500			Hargett Farm (City)	26						0	25,000	25,000	25,000	50,000	10,000	60,000	15,000	75,000		75,000		75,000	City Owned, allocation TBD
54" Int.	1500			Overlook Sec. 8	27	32	DU	175		3,500	3,500	2,100	5,600		5,600		5,600		5,600		5,600		5,600	
54" Int.	1500			Renn	34	220	Ac.	1,400			0		0		0	123,200	123,200	184,800	308,000		308,000		308,000	
54" Int.	1500			Emerald Farm	40	185	DU	250	44,750	1,500	46,250		46,250		46,250		46,250		46,250		46,250		46,250	
54" Int.	1500			Bower's Park	41	21	DU	250		5,250	5,250		5,250		5,250		5,250		5,250		5,250		5,250	
54" Int.	1500			Waverly View / Krantz	42	732	DU		0	34,075	34,075	100,850	134,925		134,925		134,925		134,925		134,925		134,925	none existing
54" Int.	1500			Summers Farm - Mixed	49	100	Ac.				0		0		0	34,570	34,570	51,854	86,424		86,424		86,424	
54" Int.	1500			Summers Farm - Adjacent	50	110	DU	250			0		0		0	11,000	11,000	16,500	27,500		27,500		27,500	
54" Int.	1500			Tasker's Chance	53	259	DU	250	64,750		64,750		64,750		64,750		64,750		64,750		64,750		64,750	
54" Int.	1500			Whittier	56	249	DU	250	62,250		62,250		62,250		62,250		62,250		62,250		62,250		62,250	
54" Int.	1500			Walnut Ridge	58	521	DU	175	55,475	24,675	80,150	11,025	91,175		91,175		91,175		91,175		91,175		91,175	
54" Int.	1500			Carroll Creek Project	60	20	Ac.	2,000	20,000		20,000	5,000	25,000	15,000	40,000		40,000		40,000		40,000		40,000	
54" Int.	1500			Frederick Brickworks	61A	219	Ac.	1,400			0		0	306,600	306,600		306,600		306,600		306,600		306,600	
54" Int.	1500			Dewey Jordan Annex.	61B						0		0	20,232	20,232		20,232		20,232		20,232		20,232	
54" Int.	1500			Berger Annex.	106						0		0		0		0		0		0		0	No Annexation Request
54" Int.	1500			Hooper Annex.	107	886	DU				0		0		0	67,800	67,800	101,700	169,500		169,500		169,500	
54" Int.	1500			Brooklawn	201	68	DU	175		4,725	4,725	7,175	11,900		11,900		11,900		11,900		11,900		11,900	No Annexation Request
54" Int.	1500			Cramer Property	203	53	DU	250		13,250	13,250		13,250		13,250		13,250		13,250		13,250		13,250	
54" Int.	1500			Galleria @ Carroll Creek	204	127	DU	175	6,125	16,100	22,225		22,225		22,225		22,225		22,225		22,225		22,225	
54" Int.	1500			Rocky Pointe	206	15	DU	250	3,500	250	3,750		3,750		3,750		3,750		3,750		3,750		3,750	
54" Int.	1500			West & South Frederick					4,533,150		4,533,150		4,533,150		4,533,150		4,533,150		4,533,150		4,533,150		4,533,150	match average meter readings - line below
54" Int.	1500			54" Carroll Creek Interceptor Load					4,800,000	143,500	4,943,500	219,650	5,163,150	414,832	5,577,982	338,529	5,916,511	429,793	6,346,304	0	6,346,304	0	6,346,304	
82-R	2			Airport					20,000		20,000		20,000	0	20,000		20,000		20,000	941	20,941	8,467	29,408	
82-R	2			Plant Recycle					0		0		0	0	0		0		0		0		0	not in metered infl/effl readings; only plant flow
82-R	2			Manhole 2 (C: 82-R) Load					20,000	0	20,000	0	20,000	0	20,000	0	20,000	0	20,000	941	20,941	8,467	29,408	
				City of Frederick WWTF City Flow					6,639,598	330,625	6,970,223	534,535	7,504,758	850,532	8,355,290	408,529	8,763,818	534,793	9,298,611	941	9,299,552	8,467	9,308,019	reflects plant average readings
				City of Frederick WWTF Total Influent Flow					8,815,132	514,766	9,329,898	934,028	10,263,926	1,874,905	12,138,832	1,031,284	13,170,116	1,194,276	14,364,392	24,611	14,389,003	221,495	14,610,497	
#90-A				City Bypass Flow					0	0	0	0	0	0	355,290	408,529	763,818	534,793	1,298,611	941	1,299,552	8,467	1,308,019	Does not include Upper Monocacy Flow
105-D	39			Airport Park (FAPA)	33						0		0		0	119,366	119,366	179,048	298,414		298,414		298,414	
105-C	34			Linganore Interceptor (MH#34 C: 105-C) Load					1,600,000		1,600,000	750,000	2,350,000	750,000	3,100,000	180,000	3,280,000	270,000	3,550,000	45,000	3,595,000	405,000	4,000,000	From 2006 Wastewater Collection and Outall Corridor Analysis Report
105-A	8			Bush Creek Interceptor (MH#8C: 105-A) Load						15,000	15,000	300,000	315,000	355,000	670,000	130,000	800,000	300,000	1,100,000	70,000	1,170,000	630,000	1,800,000	From 2006 Wastewater Collection and Outall Corridor Analysis Report
105-A	8			Urbana Interceptor (MH#8 C: 105-A) Load					600,000	300,000	900,000	400,000	1,300,000	400,000	1,700,000	260,000	1,960,000	390,000	2,350,000	15,000	2,365,000	135,000	2,500,000	From 2006 Wastewater Collection and Outall Corridor Analysis Report
200	4			Ballenger Creek Interceptor (MH#4 C: 200) Load					1,000,000	300,000	1,300,000	650,000	1,950,000	650,000	2,600,000	180,000	2,780,000	270,000	3,050,000	45,000	3,095,000	405,000	3,500,000	From 2006 Wastewater Collection and Outall Corridor Analysis Report and 425,000 gpd infiltration from field tests
200	4			Buckeystown Interceptor (MH#4 C: 200) Load					56,000	46,000	100,000	150,000	250,000	150,000	400,000	120,000	520,000	180,000	700,000	30,000	730,000	270,000	1,000,000	From 2006 Wastewater Collection and Outall Corridor Analysis Report
				Lower Monocacy Flow					3,256,000	661,000	3,915,000	2,250,000	6,165,000	2,305,000	8,825,290	1,397,894	10,223,184	2,123,841	12,347,025	205,941	12,552,966	1,853,467	14,406,433	Does not include Upper Monocacy Flow
				Ballenger Creek WWTP Influent Flow					5,431,534	845,141	6,274,676	2,649,493	8,924,169	3,329,373	12,608,832	2,020,650	14,629,481	2,783,325	17,412,806	229,611	17,642,417	2,066,495	19,708,911	

Appendix B

MEMORANDUM

Date: October 19, 2012

To: Kevin Demosky

From: Andrew Cooper

Subject: Peak Flow Factor

CC: Mike Marschner, Rod Winebrenner, Bud Creighton, Scott Shipe, Zack Kershner, Gene Walzl, Francis Bonkowski, Michael Olivier, Dennis Hasson

Work Order Number: 013861003

Contract Number: McKinney – Ballenger CO#17

Project: Monocacy Sewershed Wastewater Utility Study – Phase II

Whitman, Requardt, & Associates (WR&A) is in receipt of the September 4, 2012 and July 5, 2012 correspondence from Frederick County (County) and Frederick City (City), respectively, regarding the peak flows being used for flow projections for the Monocacy Sewershed Wastetwater Utility Study. WR&A used peak hour flows for evaluating the collection and conveyance system based on generally accepted design guidelines (Metcalf & Eddy). Since flow data were available, peak hour flow factors were determined from a metered event in March 2010, which when combined with accumulated snowfall corresponds to a 10-25 year storm. This same incident was used to evaluate the Howard County sewer system during their recent Master Plan update as well as the design criteria for their new Little Patuxent Interceptor upgrades. The County and the City have indicated the selected storm may represent an extreme event that skews proposed flow projections to be overly conservative.

In their letter, the County calculated peak factors based on MDE's guidelines for the Ceresville Sewage Pumping Station (SPS) and Ballenger-McKinney Wastewater Treatment Plant (WWTP). MDE guidelines recommend designing sewer systems based on a Design Hydraulic Flow, which is made up of peak domestic and commercial flow as well as an infiltration and inflow allowance. The peak flows are determined from the peak flow equation ($Q_P = 3.2 \times Q_A^{5/6}$) that allows for peak flows to become attenuated as the average flows increase as a result of an expanding sewer system. Applying the MDE equation to existing average flows, the County calculated a peak factor of 2.83 for the Ceresville SPS and 2.62 for the Ballenger-McKinney WWTP, which they increased to 3.0 and 2.75, respectively.

In their letter, the City calculated a peak factor based on MDE as well and found that for the average flow reaching the City WWTF, the peak factor is 2.3. Reviewing the past four (4) years of data, the average peak day flow factor was determined to be 3.1. Since this is more conservative, the City proposed to use this peak factor for existing flows.

Table 1 and Figure 1 illustrate the differences in peak factors used between Phase I and the proposed changes noted above for Phase II. The adoption of peak factors as stated from the County and City letters is suitable for planning level analysis. It is recommended to continue metering flows in order to further validate the assumptions used to develop the model. If metering indicates that actual peak flow factors are greater than the assumed values noted above, sizing and phasing of capital improvements will need to be re-evaluated.

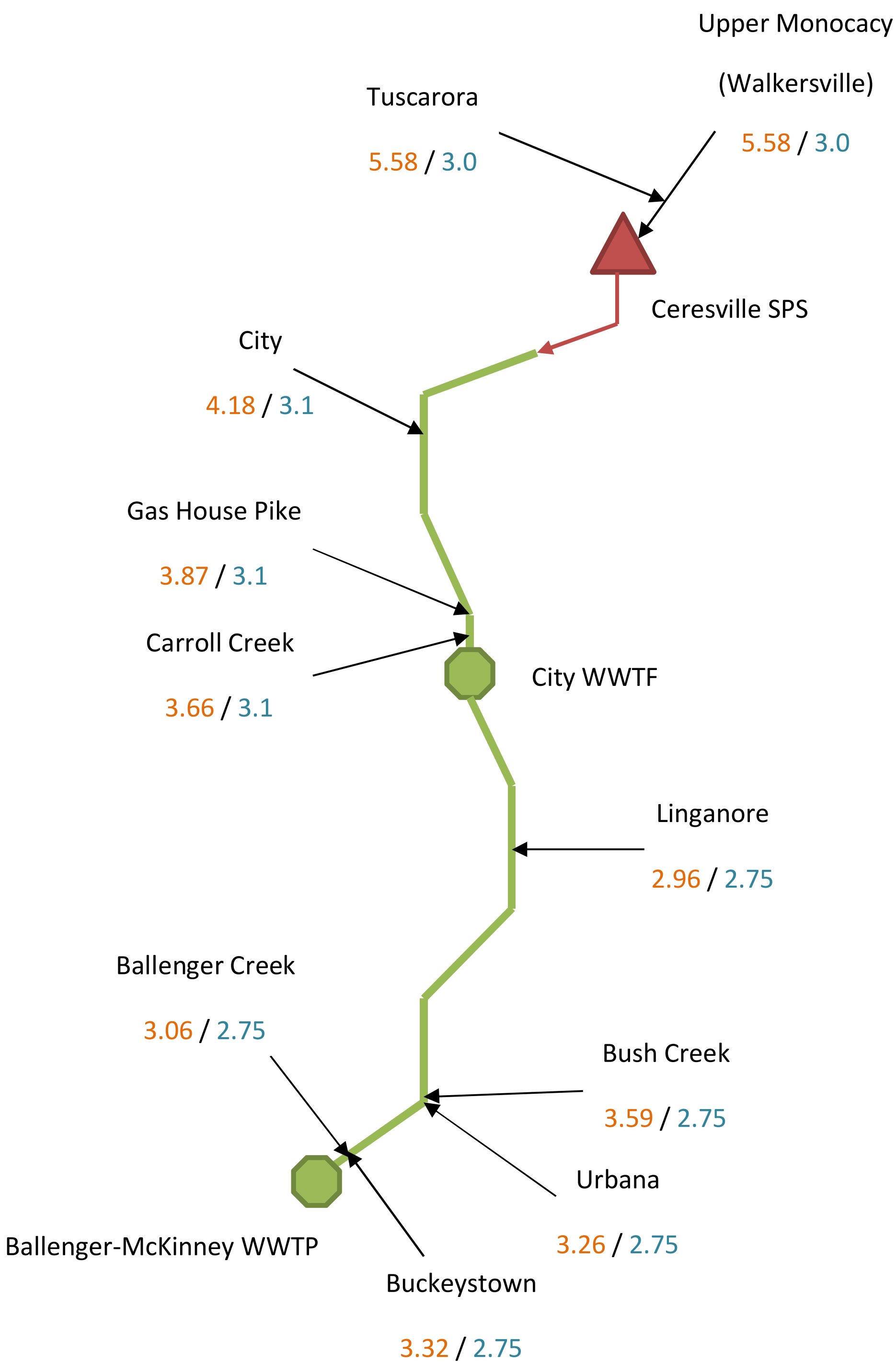
Table 1: Peak Factors		Peak Factors		
Location		Phase I	County	City
Ceresville SPS		5.58	3.0	
City WWTF	City Interceptor	4.18	N/A	3.1
	Gas House Pike	3.87		
	Carroll Creek	3.66		
Balenger-McKinney WWTP*	Linganore	2.96	2.75	N/A
	Bush Creek	3.59		
	Urbana	3.26		
	Ballenger Creek	3.06		
	Buckeystown	3.32		
*Note: All interceptors connecting to the Lower Monocacy Pressure Sewer are based off of the MDE equation with the peak factors shown for the Currently Allocated Timestep				

Regarding the overall treatment capacity as it relates to the maximum allowable nutrient loading, we understand the timing is dependent on actual projected growth rates based on input from the Land Use Council and actual flow per EDU as determined from historical records. There is some evidence that suggests that actual flow rates are less than the planning values used in the Study. Based on a review of historical flow increase trends, the maximum allowable treatment capacity based on nutrient loading will likely not be reached in the near future.

Now that a revised peak flow strategy has been agreed upon for planning purposes, the model will be re-processed to utilize these values at each given timestep, including an intermediate step when currently negotiated treatment capacity is reached. At this time, we plan to proceed with Phase II infrastructure planning and development associated with the treatment capacity limitation. Consideration will also be given for flows beyond the current treatment capacity allocation.

P. Andrew Cooper, P.E., BCEE

Figure 1: Interceptor Peaking Factors (Phase I / Phase II)



*Note: All interceptors connecting to the Lower Monocacy Pressure Sewer are based off of the MDE equation with the peak factors shown for the Currently Allocated Timestep.

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UTILITIES AND SOLID WASTE MANAGEMENT DIVISION
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September 4, 2012

Mr. P. Andrew Cooper, P.E.
Whitman, Requardt & Associates, LLP
801 South Caroline Street
Baltimore, MD 21231

RE: City/County Sewer Study – Peaking Factor
County Contract 105F-S

Dear Mr. Cooper:

The Frederick County Division of Utilities and Solid Waste Management (DUSWM) in conjunction with the City of Frederick (City) has developed a course of action with respect to the sewer study peaking factor. Whitman, Requardt and Associates, LLP (WR&A) presented various peaking factors in their correspondence of May 31, 2012 and from Phase I of the study. The problem faced by all parties is agreeing to the peaking factor that should be applied to the average flows so that the system capacity can be accurately evaluated. Section 3.1.5.3 of the DUSWM design manual states that the peak flow (MGD) shall be derived from the Maryland Department of the Environment (MDE) peaking equation as shown below.

$$Peak\ Flow\ (MGD) = 3.2\ \times (Average\ Flow)^{(5/6)}$$

WR&A developed a peak flow based from "peak hour" events shown on historical data.

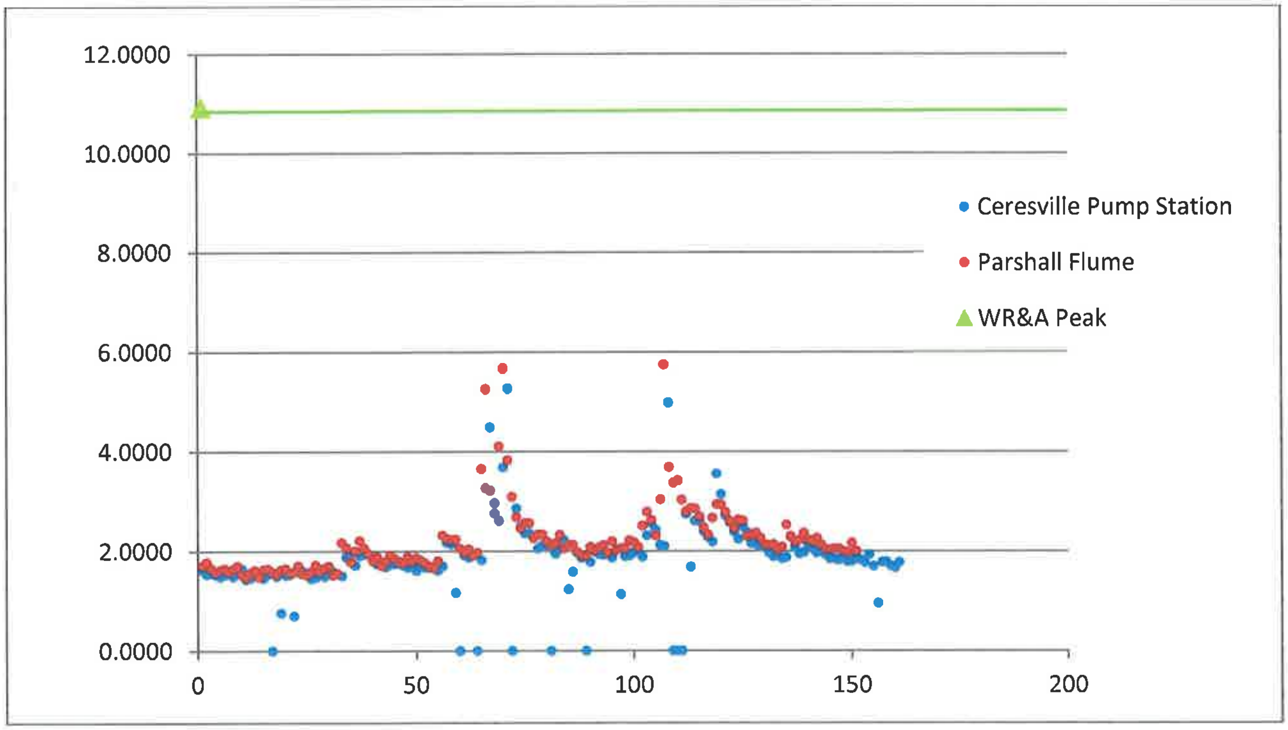
$$Peak\ Hour\ Peak\ Factor = Peak\ Hour\ Flow\ \div Annual\ Average\ Daily\ Flow$$

The MDE curve is a predetermined equation used to predict peak flow while the WR&A method looks at a specific event in the history of the sewer shed to base future events. Based on WR&A's method we would design around the most extreme historical event. Use of an extreme would therefore capture the "anomaly." WR&A used an event that occurred during the week of 3/11/10 to 3/17/10 and measured a flow of 11.99 MGD. A value of 10.92 MGD was extracted for the Ceresville sewage pumping station (CSPS) based on its percentage of contribution. The peaking factor was then calculated to be 5.58. A graphical illustration of how this peak compares to other historical data is shown on the attached scatter plot for the period 1/1/11 to 5/31/11. The CSPS currently has a maximum pump capacity of approximately 6.7 MGD (one pump on w/spare off). The maximum design pump rate for CSPS at ultimate build out (4 pumps) is approximately 14 MGD. According to WR&A's method, the current design peak flow used in the study would put CSPS at only 2.06 MGD less than its future maximum design pumping rate of 14 MGD.

Given the fact that CSPS has functioned well for many years without the 3rd and 4th pumps, which are included in the maximum pumping rate design, this suggests that WR&A's peaking factor may be overly conservative.

The table below compares the WR&A method, MDE method and actual flow data at Ceresville SPS for the time frame used for the scatter plot.

	Average Flow	Peak Flow	Peak Factor
WR&A Ceresville Flow	2.10	11.90	5.67
Ceresville (Actual Flow Data)	1.86	5.26	2.83
Ceresville (Using MDE Peak)	1.86	5.37	2.89



The DUSWM believes that the MDE peaking factor applied to average flow (MDE method) yields a conservative yet more realistic basis for design at the Ceresville sewage pumping station.

Ballenger-McKinney WWTP was shown in the Phase I report to have an average daily flow of 7.6 MGD with a peak flow of 21.5 MGD, which yields a peaking factor of 2.82. Since 2005 the highest average daily flow at Ballenger was 5.82 MGD and a maximum daily flow of 15.28 MGD which yields a peak of 2.62. The MDE peaking factor would put the 5.8 MGD average at a peak of 13.9 MGD.

Reasonably, the actual peaking factor of 2.62 could be used, which is slightly lower than the WR&A design peaking factor used at Ballenger-McKinney.

	Average Flow	Peak Flow	Peak Factor
2012 WR&A (to Ballenger Table 3.2)	7.68	21.50	2.80
2012 (Actual Flow Data to Ballenger)	5.82	15.28	2.62
Ballenger Using MDE Peak	5.82	13.89	2.39

The two examples cited and the data provided in the attached letter from Frederick City demonstrate why the WR&A's method is considered overly conservative. Frederick County advises that a peaking factor of 2.75 be used for the Ballenger McKinney WWTP (Peak Day/Average Day) while a factor of 3.0 be used for the Ceresville sewage pumping station (MDE Calculated Peak) for the existing flows. These numbers are slightly above those calculated to provide a minor safety factor. Future flows should be based upon the MDE peaking factor.

I recommend the parties establish a teleconference to discuss this issue in more detail once you have had an opportunity to review the information presented above. If you have any questions, please contact Mr. Robert Creighton, Engineering Manager, at (301) 600-2962, or via email at rcreighton@FrederickCountyMD.gov.

Sincerely,

Kevin L. Demosky
Director, DUSWM

Attachments: Letter from City of Frederick July 5, 2012
WR&A Letter 5/31/12

Citations
(P. Andrew Cooper 2012)
(Kershner 2012)

cc: Dennis Hasson, WR&A
Zack Kershner, City of Frederick
Michael Marschner, Special Projects Manager
Rodney Winebrenner, DUSWM
Robert Creighton, DUSWM
File/ 105F-S(1)

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July 5, 2012

Mr. Kevin L. Demosky, Director
Frederick County DUSWM
4520 Metropolitan Court
Frederick, MD 21704

Dear Mr. Demosky:

We have received correspondence from Robert Creighton of your department requesting comment on a letter from Andrew Cooper of Whitman Requardt & Associates (WRA) dated May 31, 2012, regarding the determination and use of sewer peaking factors. After much review and discussion about this complex subject, we would like to offer the following points for your consideration in formulating a response to Mr. Cooper:

1.) The calculated sewer flow for the existing timestep at the headworks of the Gas House Pike WWTP found in the Sanitary Load Allocation Table (SLAT) of the WRA Phase I Report are approximately 10% greater than the metered value as shown on the spreadsheet below. Our suggestion to WRA would be to utilize the metered data to the degree possible under the 'existing' scenario to calibrate the model.

2.) The values in the SLAT for Flow/Unit appear to be the standard average water-usage figures used by both the County and the City, i.e., 250 gpd = 1 SF dwelling. Although it is generally known that the full amount of water consumed does not enter the sewer system, the true amount varies widely according to development use type. It could be said, though, that the amount of water that does not enter the sewer on an average daily basis is approximately equal to the amount of infiltration that does, and therefore the unit flow figures roughly account for the sewer use plus base infiltration. If it is accepted that the unit flow values for water use are correct for sewer use, adding a separate value for infiltration would produce a doubling effect for infiltration at the major points of interceptor connection.

3.) It appears as though the MDE curve for calculating peak sewer flow is not being applied appropriately at the headworks of the GHP WWTP. The **expected peak** at the headworks based on the MDE curve equation and the average daily flow value as metered should be approximately 20 mgd (for an average flow, Qa, ≈ 8.7 mgd; P.F = 2.3).

4.) In our professional opinion, it is questionable to use the Peak Hour flow value in calculating the peaking factor for design of improvements to all sewer infrastructure, in particular the sewer collection system. The MDE curve utilizes the Peak Day amount divided by the Average Day. We would recommend utilizing a peaking factor calculated as: Peak Day ÷ Average Day for modeling purposes of existing flow. The Peaking Factor as determined using this ratio for the GHP WWTP headworks ≈ 3.1.

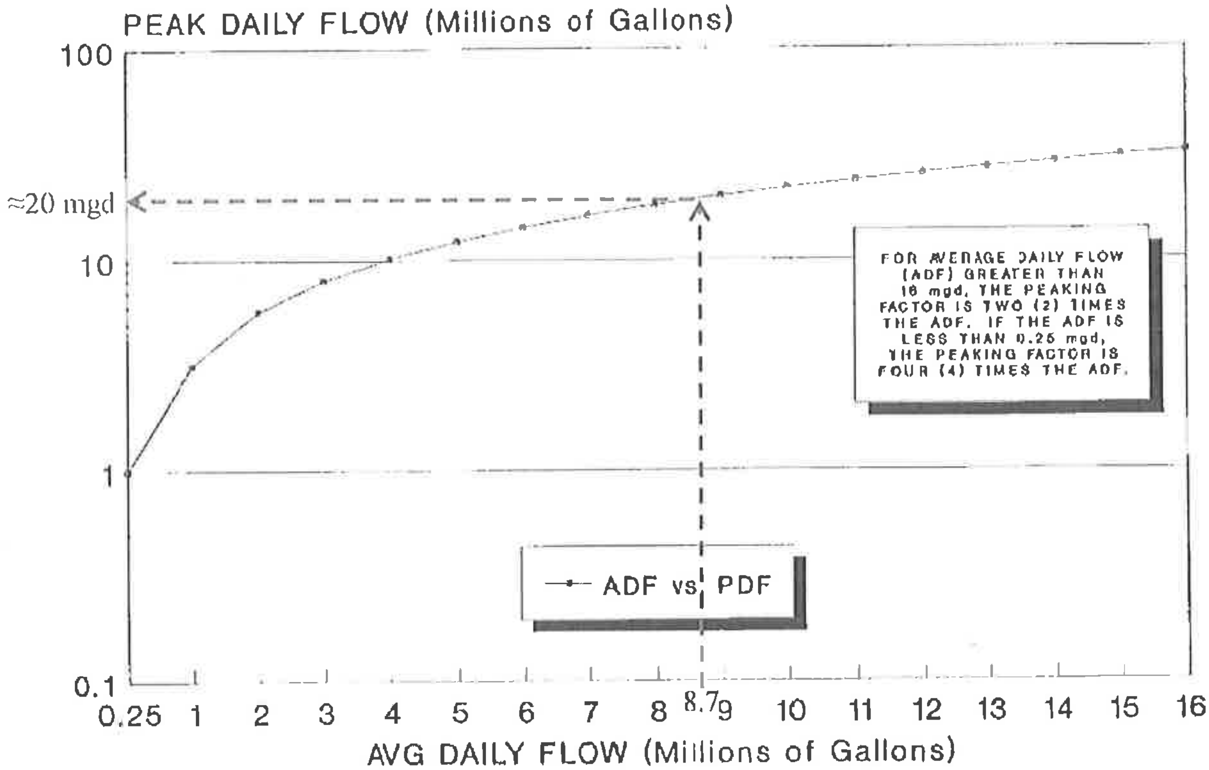
5.) It is also our opinion that the materials and construction methods of sewer pipe installed new at each timestep is subject to I&I problems to a much lesser degree than that of the older pipe. For this reason, we suggest that the MDE curve should be used to calculate the peak for future **additional** flows. In other words, the existing average daily flow amounts for the preceding timestep should be peaked using the expected peaking factor as described in 4.) above and, for each future timestep, the estimated additional flow should be peaked according to the MDE curve which would be less than that of the preceding timestep. For further explanation of this concept, please refer to the example calculations on the following pages.

Comparison of Peak / Average GHP Sewer Flows

Year	Peak Influent[1]	Average Influent[1]	Peak Effluent[1]	Average Effluent[1]	Influent P.F.	Effluent P.F.	Max Day Date[1]	Peak Hour Infl on Max Day[1]	Day of Peak Hour[1]	Peak Hour/ Ave Day	MDE P.F. Qp=3.2*Qa^5/6
2000	14.92	7.73	11.33	6.48	1.9	1.7	3/22/00	n/a	-	n/a	2.3
2001	14.22	7.52	10.66	5.66	1.9	1.9	3/30/01	n/a	-	n/a	2.3
2002	13.76	7.16	12.33	6.43	1.9	1.9	12/14/02	n/a	-	n/a	2.3
2003	31.16	10.91	18.05	8.51	2.9	2.1	12/11/03	33.9	12/11/03	3.1	2.1
2004	21.93	9.69	15.98	6.88	2.3	2.3	2/7/04	29.1	2/7/04	3.0	2.2
2005	21.97	8.97	14.67	6.93	2.4	2.1	4/2/05	33.5	4/3/05	3.7	2.2
2006	15.10	8.06	12.48	6.26	1.9	2.0	6/28/06	n/a	-	n/a	2.3
2007	19.05	7.85	13.11	6.28	2.4	2.1	3/2/07	n/a	-	n/a	2.3
2008	25.65	8.06	21.31	6.47	3.2	3.3	5/12/08	32.6	5/12/08	4.0	2.3
2009	27.01	8.17	19.28	6.38	3.3	3.0	12/27/09	35.0	12/26/09	4.3	2.3
2010	25.72	8.76	18.46	6.55	2.9	2.8	3/14/10	35.0	3/14/10	4.0	2.2
2011	24.34	8.69	15.31	6.49	2.8	2.4	11/23/11	29.9	11/23/11	3.4	2.2
					Average Influent P.F.	Average Effluent P.F.				ave.	ave.
					2.5	2.3				3.7	2.2
				past 5 years ->	2.9						
				past 4 years ->	3.1						

[1]all figures from WWTP report, on "annual basis", in mgd)

MDE PEAK FLOW CURVE
FROM 0.250 TO 16 MILLION GALLONS PER DAY



Peaking Factor using the MDE curve above: 20 mgd / 8.7 mgd = 2.3

While we realize the City sewer system is not as 'tight' as to suggest using a peaking factor of 2.3, it is our opinion that the factor used by WRA of 4.1 (40.48 mgd / 9.868 mgd, from figure 4 and SLAT in Amendment No. 1) is unnecessarily conservative in light of the above information. Furthermore, when the peaked flow from Figure 4 is divided by the average flow from the SLAT at MH#1 (139-A) which is the Upper Monocacy flow, the peaking factor is 5.39 (12.79 mgd / 2.372 mgd, Existing Steady State).

It is recommended that the Expected Peaking Factor of 3.1 as expressed in #4 above be applied to the average daily flow to obtain reasonable peak design flows to the headworks of the Gas House Pike WWTP. While we are still concerned that the SLAT provides existing average daily influent flow of 9.87 mgd at GHP WWTP which is higher than the metered flow values from plant records of 8.7 mgd, the expected peak flow value based on the SLAT would be 30.6 mgd (9.87 mgd x 3.1) using the expected peaking factor and records show peak daily flows of this general magnitude have reached the headworks in the past (2003, 2009). Therefore, we find this peaking factor value to be reasonable for existing flows.

Furthermore, as explained in No. 5 above, for subsequent timesteps including Currently Allocated, it is our professional opinion that the additional flow accumulated at each timestep be peaked by the MDE peaking factor, 2.3 which more correctly yields peak flow corresponding to the age and condition of the newer pipe which carries it. For example, at the headworks to the GHP WWTP MH#1:

Existing Average Daily Flow (SLAT) x Expected P.F. = Existing Peak Flow
9.87 mgd x 3.1 = 30.6 mgd

Additional Currently Allocated Average Daily Flow* x MDE P.F. = Additional Curr. Alloc. Peak Flow
0.498 mgd* x 2.3 = 1.15 mgd

Total Existing and Allocated Peak Flow = 30.6 mgd + 1.15 mgd = 31.75 mgd

This is in contrast to the value of 42.79 mgd shown as Total Flow to the headworks in Fig 2 & 3, WRA rpt.

Example using flow at MH#1 (139-A):

Existing (SLAT) x Expected P.F. = Existing Peak Flow
2.37 mgd x 3.1 = 7.35 mgd

Additional Curr. Alloc*. X MDE P.F. = Additional Curr. Alloc. Peak Flow
0.153 mgd* x 2.3 = 0.352 mgd

Total Existing and Allocated Peak Flow at MH#1 (139-A) = 7.35 mgd + 0.352 mgd = 7.702 mgd

Again, this is in contrast to the value of 13.70 mgd shown as Currently Allocated peak flow to MH#1 (139-A) on Figure 2, WRA report.

* Calculated by subtracting Cuurently Allocated value from Existing timestep value in SLAT.

We trust that the above material helps to clarify our position on the establishment of reasonable sewer flow factors for modeling the City's collection system, but if there should be a need for further discussion, we would be happy to meet with you and your staff at your earliest convenience.

Sincerely,

Zachary J. Kershner, P.E.
City Engineer – City of Frederick

cc: Mike Marschner
Rodney Winebrenner
Robert Creighton
Gene Walzl

WHITMAN, REQUARDT & ASSOCIATES, LLP
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MEMORANDUM

Date: May 31, 2012

To: Michael Marschner

From: P. Andrew Cooper, P.E.

Subject: Peak Flow Factor and Capacity Evaluation

CC: Francis Bonkowski, Michael Olivier, Dennis Hasson, Bud Creighton, Rod Winebrenner, Scott Shipe, Kevin Demosky, Zack Kershner, Gene Walzl

Work Order Number: 013861003

Contract Number: McKinney – Ballenger CO#17

Project: Monocacy Sewershed Wastewater Utility Study – Phase II

On April 25, 2012 WR&A met with Frederick City (City) and Frederick County (County) to discuss the Phase II modeling and possible alternatives for development of the wastewater Capital Improvement Plan (CIP) for the above referenced project. It was noted during the workshop that the original peak flows for the March 2010 rain event used in Phase I of the study may not be representative of typical system responses to storm events. Also, the County expressed concern with modeling flows that exceed the maximum nutrient loading allowed into the Chesapeake Bay as defined by the State of Maryland's Watershed Implementation Plan (WIP).

In the event that the peak flows modeled were uncharacteristically high, the City and County want to evaluate the effect of reducing peaking factors from those observed during the March 2010 rain event to typical values based on the Maryland Department of the Environment (MDE) formula. The MDE approach will use the formula to calculate a peak flow based on the average daily flow at each timestep for segments in the system. In order to allow the peaks to be representative of sub sewer sheds, the MDE formula was applied to flows from each collecting sewer. For example, the Tuscarora and Upper Monocacy (Walkersville) interceptors are each calculated as separate flows as opposed to the total average flow at Ceresville Pumping Station. Due to lack of information on the Lower Monocacy during the modeled rain event in March 2010, the collecting interceptor flows connected to the pressure sewer already use the MDE formula to estimate the peak flow factors. In addition, the peak factors developed for Phase I used the MDE formula for cumulative growth beyond the currently allocated timestep upstream of the City WWTF. As a result, the peak flows beyond the currently allocated timestep will increase at a similar rate for MDE as they did in Phase I. A graph (**Figure 1**) is included to compare the peak flow reaching the City WWTF influent pump station at each timestep interval for both Phase I and MDE methods. The greatest difference in flow is attributed mainly to the variation in peaking factors at the currently allocated timestep.

In order to develop a realistic CIP for regional wastewater improvements, the County wants to evaluate the actual treatment capacity available for future growth. The maximum allowable nutrient loading is 26 MGD average daily flow based on the WIP, with 8 MGD available at the City WWTF and 18 MGD available at Ballenger-McKinney WWTP. During Phase I a sanitary load allocation table (SLAT) was developed for all estimated growth through 2040, totaling 34 MGD average daily flow between the City and County. The County has expressed concern regarding their ability to gain additional nutrient capacity beyond the limit in the WIP. Therefore, system improvements will be evaluated assuming a combined treatment capacity of 26 MGD to show the required conveyance capacity improvements. Figure 1 also shows a line indicating the timeframe where 26 MGD would be reached for the benefit of the City and County for planning purposes. At current projections, this is anticipated to be 2024. Any changes to the growth rates or projected timing will affect when the system meets the capacity limit. Therefore, it is critical to obtain feedback in this regard from the Land Use Council. **Figure 2** and **Figure 3** show hydraulic grade lines (HGL) of full buildout at 2040 and the treatment capacity limit at 2024 for both MDE peak factors and the original Phase I peak factors. For illustration purposes, the modeling shown on both Figures assumes that all flow from the City Interceptor enters the City of Frederick WWTF, County portions of that flow and any City flows exceeding the WWTF capacity are pumped to the Lower Monocacy via the existing equalization basin pumping station, and no infrastructure improvements are included other than the parallel sewer across Carroll Creek.

Based on the evaluation of all four scenarios (years 2024 and 2040 with peak flow based on MDE and the Phase I calculated factors), the peak flows could vary over 20 MGD depending on the methodology and treatment constraints. The greatest variation of flow in the City Interceptor comes from the difference between peak factors during the currently allocated timestep.

The City Interceptor as shown on Figure 2 is predicted to have SSOs occur for all scenarios except the 2024 capacity using MDE peak factors. In this scenario, there is still surcharging within the gravity sewer that is close to causing an SSO during the peak hourly flow, and dynamic instantaneous flows could result in an SSO. Once the capacity within the gravity sewer is exceeded, even slight increases in flow can cause significant increases in the HGL as there is little storage in the system. The Facilities Plan Report generated in 2010 by WR&A for the City estimated future peak flows of 53.4 MGD at the City WWTF, based on a peak factor of 3.75 and a target peak factor of 2.8. The MDE assumption above equates to a peak factor of 2.61 in 2024 and 2.59 in 2040. The effort required to reduce peak factors to a similar level as MDE may not be feasible.

Similar to the City Interceptor, the Lower Monocacy HGLs on Figure 3 estimate that the 2024 MDE assumption is the only scenario without a probable SSO on the trunk line. A few gravity connections that feed into the pressure sewer appear to have surcharging above the lowest gravity connection, so will need to be converted to pumped systems. The Ballenger-McKinney Plant was designed for a peak factor of 2.5, whereas the 2040 peak factor based on the MDE assumption is 2.15 including bypassed flows from the City WWTF.

The City and County can decide on the method to calculate peak factors that best suits their intended purposes for planning their respective CIP schedules. It is certainly possible that ultimate peak flow decisions can be a compromise between the two methods presented.

We intend to suspend further infrastructure recommendations until a decision has been reached on the appropriate peak flow factors. Once an appropriate peak flow strategy has been agreed upon, the model can be re-processed to utilize these values at each given timestep, including an intermediate step when existing treatment capacity is reached, and infrastructure planning can reconvene.

We are available to discuss at your convenience. If you have any questions, please contact me.

P. Andrew Cooper, P.E.

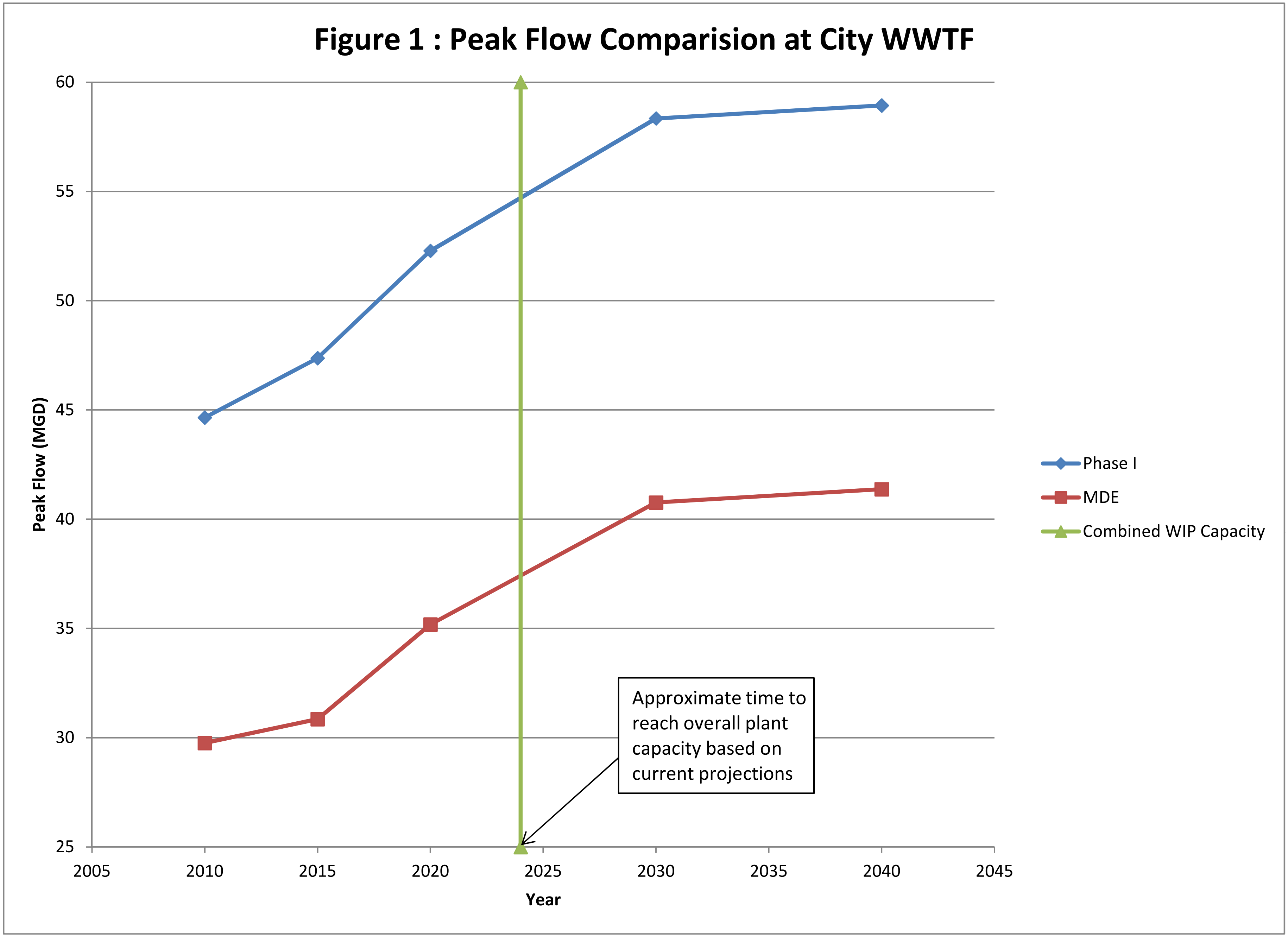
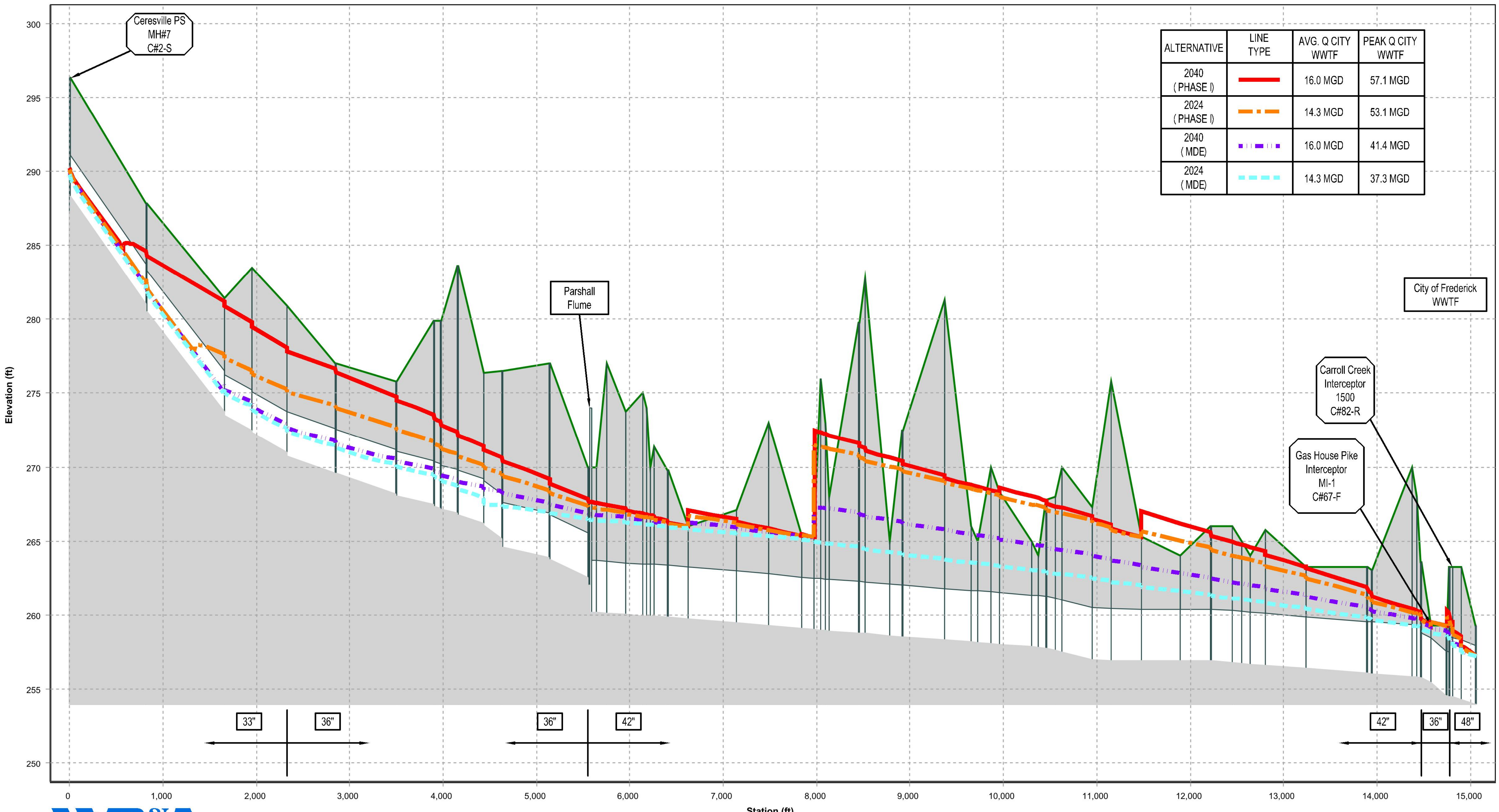


Figure 1 : Peak Flow Comparision at City WWTF
Peak Flow (MGD)
60
55
50
45
40
35
30
25
2005
2010
2015
2020
2025
2030
2035
2040
2045
Year
Phase I
MDE
Combined WIP Capacity
Approximate time to reach overall plant capacity based on current projections

FIGURE 2: CITY INTERCEPTOR ALTERNATIVES

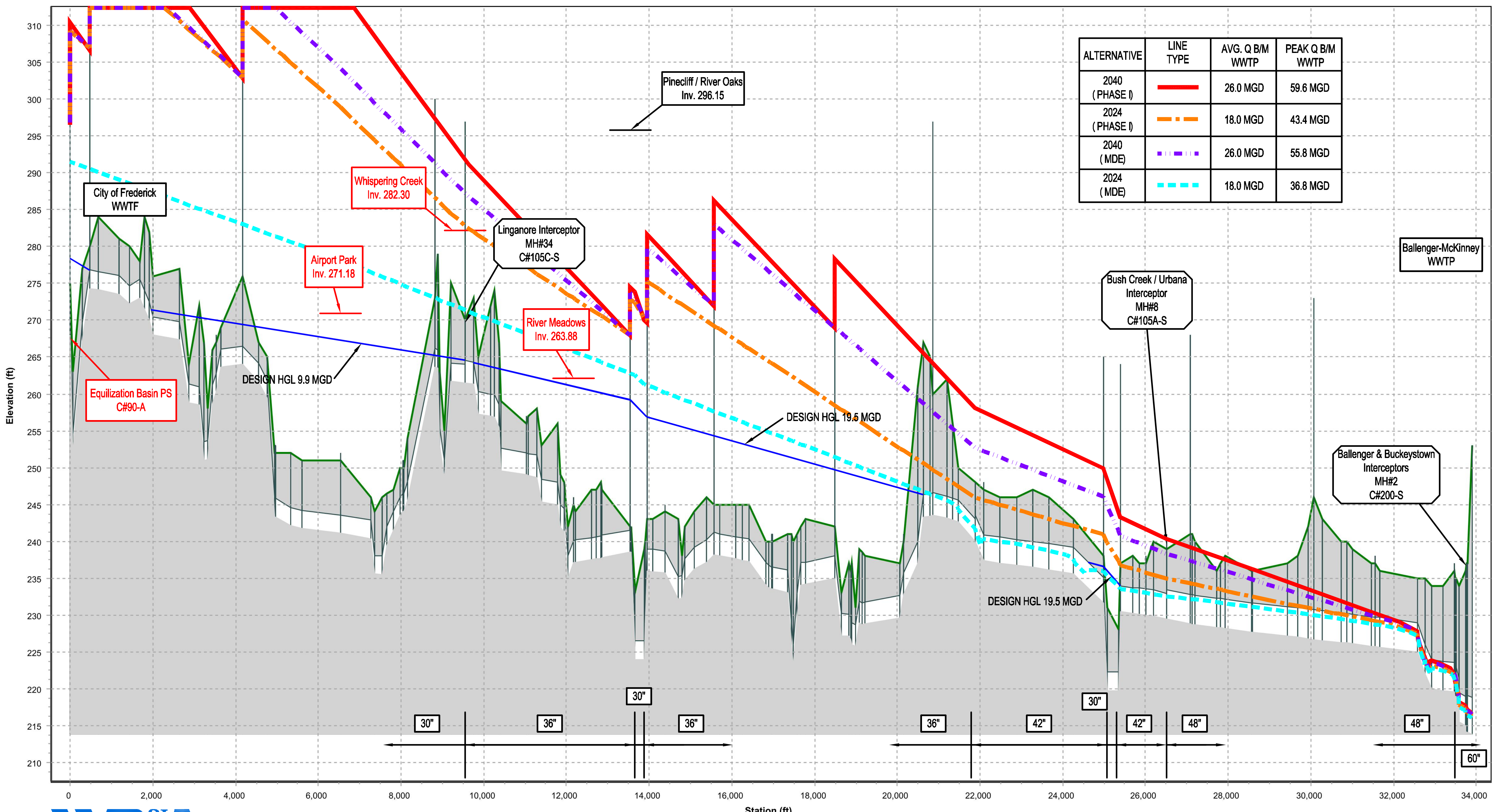


ALTERNATIVE	LINE TYPE	AVG. Q CITY WWTF	PEAK Q CITY WWTF
2040 (PHASE I)		16.0 MGD	57.1 MGD
2024 (PHASE I)		14.3 MGD	53.1 MGD
2040 (MDE)		16.0 MGD	41.4 MGD
2024 (MDE)		14.3 MGD	37.3 MGD

WHITMAN, REQUARDT & ASSOCIATES, LLP
801 South Caroline Street, Baltimore, Maryland 21231

Figure 2
May 2012

FIGURE 3: LOWER MONOCACY PRESSURE SEWER ALTERNATIVES



WR&A
WHITMAN, REQUARDT & ASSOCIATES, LLP
801 South Caroline Street, Baltimore, Maryland 21231

Figure 3
May 2012

Appendix C

Frederick County & City
Monocacy Sewershed Wastewater Utility Study
Flow Metering Program

FLOW METERING PROGRAM				
TASK DESCRIPTION	**UNIT**	**QUANTITY**	**UNIT COST**	**TOTAL COST**
Flo-Dar Metering Device	EA	7	$13,000	$91,000
Flow Meter Installation	EA	7	$500	$3,500
Subtotal 1				**$94,500**
Mobilization/Demobilization	(5%)	1		$5,000
Construction Contingency	(30%)	1		$29,000
Subtotal 2				**$128,500**
Project Costs	(25%)	1		$33,000
TOTAL				**$170,000**

Notes and assumptions:

1. Cost of flow metering devices assumes no additional structures or upgrades required.
2. Project Costs include Engineering Costs (10%), Construction Management (7%), Administration (5%), Bonds and Insurance (2%) and Construction Change Orders (1%).

Frederick County & City
Monocacy Sewershed Wastewater Utility Study
Ceresville Pump Station Upgrades - Intermediate

CERESVILLE PUMP STATION UPGRADES - INTERMEDIATE				
TASK DESCRIPTION	**UNIT**	**QUANTITY**	**UNIT COST**	**TOTAL COST**
Additional Pump	EA	1	$140,000	$140,000
Electrical Upgrades	LS	1	$35,000	$35,000
Subtotal 1				**$175,000**
Mobilization/Demobilization	(5%)	1		$9,000
Construction Contingency	(30%)	1		$53,000
Subtotal 2				**$237,000**
Project Costs	(25%)	1		$60,000
TOTAL				**$300,000**

Notes and assumptions:

2. Project Costs include Engineering Costs (10%), Construction Management (7%), Administration (5%), Bonds and Insurance (2%) and Construction Change Orders (1%).

Frederick County & City
Monocacy Sewershed Wastewater Utility Study
Ceresville Pump Station Upgrades - Final

CERESVILLE PUMP STATION UPGRADES - FINAL				
TASK DESCRIPTION	**UNIT**	**QUANTITY**	**UNIT COST**	**TOTAL COST**
Additional Pump	EA	1	$140,000	$140,000
Electrical Upgrades	LS	1	$35,000	$35,000
Subtotal 1				**$175,000**
Mobilization/Demobilization	(5%)	1		$9,000
Construction Contingency	(30%)	1		$53,000
Subtotal 2				**$237,000**
Project Costs	(25%)	1		$60,000
TOTAL				**$300,000**

Notes and assumptions:

2. Project Costs include Engineering Costs (10%), Construction Management (7%), Administration (5%), Bonds and Insurance (2%) and Construction Change Orders (1%).

Frederick County & City
Monocacy Sewershed Wastewater Utility Study
Parallel of Carroll Creek Crossing

PARALLEL OF CARROLL CREEK CROSSING				
TASK DESCRIPTION	**UNIT**	**QUANTITY**	**UNIT COST**	**TOTAL COST**
36" DIP Sanitary Sewer	LF	200	$550	$110,000
Furnish and Install 6' Doghouse Manhole	EA	2	$15,000	$30,000
Subtotal 1				**$140,000**
Mobilization/Demobilization	(5%)	1		$7,000
Construction Contingency	(30%)	1		$42,000
Subtotal 2				**$189,000**
Project Costs	(25%)	1		$48,000
TOTAL				**$240,000**

Notes and assumptions:
1. Cost of pipe includes excavation, backfill, and other work related appurtenances.
2. Project Costs include Engineering Costs (10%), Construction Management (7%), Administration (5%), Bonds and Insurance (2%) and Construction Change Orders (1%).

Frederick County & City
Monocacy Sewershed Wastewater Utility Study
Parallel of City Interceptor

PARALLEL OF CITY INTERCEPTOR				
TASK DESCRIPTION	**UNIT**	**QUANTITY**	**UNIT COST**	**TOTAL COST**
24" DIP Sanitary Sewer	LF	5,565	$240	$1,335,600
Furnish and Install 5' Manhole	EA	7	$10,000	$70,000
Junction/Diversion Chamber	EA	2	$250,000	$500,000
Subtotal 1				**$1,905,600**
Mobilization/Demobilization	(5%)	1		$96,000
Construction Contingency	(30%)	1		$572,000
Subtotal 2				**$2,573,600**
Project Costs	(25%)	1		$644,000
TOTAL				**$3,220,000**

Notes and assumptions:
1. Cost of pipe includes excavation, backfill, and other work related appurtenances.
2. Bypass Pumping is included in the price of the Junction/Diversion Chamber
3. Project Costs include Engineering Costs (10%), Construction Management (7%), Administration (5%), Bonds and Insurance (2%) and Construction Change Orders (1%).

Frederick County & City
Monocacy Sewershed Wastewater Utility Study
Partial Replacement of City Interceptor

PARTIAL REPLACEMENT OF CITY INTERCEPTOR				
TASK DESCRIPTION	**UNIT**	**QUANTITY**	**UNIT COST**	**TOTAL COST**
48" DIP Sanitary Sewer	LF	3,650	$480	$1,752,000
Furnish and Install 6' Manhole	EA	9	$15,000	$135,000
Bypass Pumping	LS	1	$250,000	$250,000
Subtotal 1				**$2,137,000**
Mobilization/Demobilization	(5%)	1		$107,000
Construction Contingency	(30%)	1		$642,000
Subtotal 2				**$2,886,000**
Project Costs	(25%)	1		$722,000
TOTAL				**$3,610,000**

Notes and assumptions:
1. Cost of pipe includes excavation, backfill, and other work related appurtenances.
2. Bypass Pumping assumes 3 months to construct done in small increments
3. Project Costs include Engineering Costs (10%), Construction Management (7%), Administration (5%), Bonds and Insurance (2%) and Construction Change Orders (1%).

Frederick County & City
Monocacy Sewershed Wastewater Utility Study
Water Treatment Plant Pumping Station - 3 MGD

WATER TREATMENT PLANT PUMPING STATION - 3 MGD				
TASK DESCRIPTION	**UNIT**	**QUANTITY**	**UNIT COST**	**TOTAL COST**
12" DIP Force Main	LF	4,100	$120	$492,000
Air Release/Vacuum & Structure	EA	3	$7,500	$22,500
Pump Station	EA	1	$5,800,000	$5,800,000
Subtotal 1				**$6,314,500**
Mobilization/Demobilization	(5%)	1		$316,000
Construction Contingency	(30%)	1		$1,895,000
Subtotal 2				**$8,525,500**
Project Costs	(25%)	1		$2,132,000
TOTAL				**$10,660,000**

Notes and assumptions:
1. Cost of pipe includes excavation, backfill, and other work related appurtenances.
2. The quantity of force main pipe assumes the use of the existing 12" raw water main.
3. Project Costs include Engineering Costs (10%), Construction Management (7%), Administration (5%), Bonds and Insurance (2%) and Construction Change Orders (1%).

Frederick County & City
Monocacy Sewershed Wastewater Utility Study
City WWTF EQ Pumping Station Upgrade - Phase I

CITY WWTF EQ PUMPING STATION UPGRADE - PHASE I				
TASK DESCRIPTION	**UNIT**	**QUANTITY**	**UNIT COST**	**TOTAL COST**
30" DIP Force Main (Phase I)	LF	12,250	$350	$4,287,500
Air Release/Vacuum & Structure	EA	4	$7,500	$30,000
Junction/Diversion Chamber	EA	1	$250,000	$250,000
Influent Pump Upgrade	EA	1	$500,000	$500,000
Screen Upgrade	LS	1	$1,500,000	$1,500,000
Pumping Station	LS	1	$9,000,000	$9,000,000
Subtotal 1				**$15,567,500**
Mobilization/Demobilization	(5%)	1		$779,000
Construction Contingency	(30%)	1		$4,671,000
Subtotal 2				**$21,017,500**
Project Costs	(25%)	1		$5,255,000
TOTAL				**$26,280,000**

Notes and assumptions:
1. Cost of pipe includes excavation, backfill, and other work related appurtenances.
2. Project Costs include Engineering Costs (10%), Construction Management (7%), Administration (5%), Bonds and Insurance (2%) and Construction Change Orders (1%).

Frederick County & City
Monocacy Sewershed Wastewater Utility Study
City WWTF EQ Pumping Station Upgrade - Phase II

CITY WWTF EQ PUMPING STATION UPGRADE - PHASE II				
TASK DESCRIPTION	**UNIT**	**QUANTITY**	**UNIT COST**	**TOTAL COST**
30" DIP Force Main (Phase II)	LF	1,750	$350	$612,500
Air Release/Vacuum & Structure	EA	1	$7,500	$7,500
Pump Station Expansion	LS	1	$3,000,000	$3,000,000
Subtotal 1				**$3,620,000**
Mobilization/Demobilization	(5%)	1		$181,000
Construction Contingency	(30%)	1		$1,086,000
Subtotal 2				**$4,887,000**
Project Costs	(25%)	1		$1,222,000
TOTAL				**$6,110,000**

Notes and assumptions:

1. Cost of pipe includes excavation, backfill, and other work related appurtenances.
2. Project Costs include Engineering Costs (10%), Construction Management (7%), Administration (5%), Bonds and Insurance (2%) and Construction Change Orders (1%).

Frederick County & City
Monocacy Sewershed Wastewater Utility Study
River Meadows Pumping Station

RIVER MEADOWS PUMPING STATION				
TASK DESCRIPTION	**UNIT**	**QUANTITY**	**UNIT COST**	**TOTAL COST**
6" PVC Force Main	LF	1,000	$60	$60,000
Air Release/Vacuum & Structure	EA	1	$3,500	$3,500
Pump Station	EA	1	$400,000	$400,000
Subtotal 1				**$463,500**
Mobilization/Demobilization	(5%)	1		$24,000
Construction Contingency	(30%)	1		$140,000
Subtotal 2				**$627,500**
Project Costs	(25%)	1		$157,000
TOTAL				**$790,000**

Notes and assumptions:

1. Cost of pipe includes excavation, backfill, and other work related appurtenances.
2. Project Costs include Engineering Costs (10%), Construction Management (7%), Administration (5%), Bonds and Insurance (2%) and Construction Change Orders (1%).

Frederick County & City
Monocacy Sewershed Wastewater Utility Study
Airport Park Pumping Station

AIRPORT PARK PUMPING STATION				
TASK DESCRIPTION	**UNIT**	**QUANTITY**	**UNIT COST**	**TOTAL COST**
6" PVC Force Main	LF	500	$60	$30,000
Air Release/Vacuum & Structure	EA	1	$3,500	$3,500
Pump Station	EA	1	$300,000	$300,000
Subtotal 1				**$333,500**
Mobilization/Demobilization	(5%)	1		$17,000
Construction Contingency	(30%)	1		$101,000
Subtotal 2				**$451,500**
Project Costs	(25%)	1		$113,000
TOTAL				**$570,000**

Notes and assumptions:
1. Cost of pipe includes excavation, backfill, and other work related appurtenances.
2. Project Costs include Engineering Costs (10%), Construction Management (7%), Administration (5%), Bonds and Insurance (2%) and Construction Change Orders (1%).

Frederick County & City
Monocacy Sewershed Wastewater Utility Study
Carroll Creek Pumping Station

CARROLL CREEK PUMPING STATION				
TASK DESCRIPTION	**UNIT**	**QUANTITY**	**UNIT COST**	**TOTAL COST**
30" DIP Force Main	LF	16,250	$350	$5,687,500
Air Release/Vacuum & Structure	EA	4	$7,500	$30,000
Pump Station	EA	1	$10,000,000	$10,000,000
Subtotal 1				**$15,717,500**
Mobilization/Demobilization	(5%)	1		$786,000
Construction Contingency	(30%)	1		$4,716,000
Subtotal 2				**$21,219,500**
Project Costs	(25%)	1		$5,305,000
TOTAL				**$26,530,000**

Notes and assumptions:
1. Cost of pipe includes excavation, backfill, and other work related appurtenances.
2. Project Costs include Engineering Costs (10%), Construction Management (7%), Administration (5%), Bonds and Insurance (2%) and Construction Change Orders (1%).

Frederick County & City
Monocacy Sewershed Wastewater Utility Study
Ballenger-McKinney WWTP 18 MGD Expansion

BALLENGER-MCKINNEY WWTP 18 MGD EXPANSION				
TASK DESCRIPTION	**UNIT**	**QUANTITY**	**UNIT COST**	**TOTAL COST**
Influent Pumping Station	LS	1	$835,000	$835,000
Headworks	LS	1	$1,930,000	$1,930,000
Fine Screening Facility	LS	1	$650,000	$650,000
Flow Equalization	LS	1	$520,000	$520,000
Aeration Basins	LS	1	$3,340,000	$3,340,000
Membrane Basins	LS	1	$16,000,000	$16,000,000
RAS/WAS Facilities	LS	1	$450,000	$450,000
Blower Facilities	LS	1	$2,150,000	$2,150,000
UV Disinfection	LS	1	$580,000	$580,000
Civil/Site Work	LS	1	$2,120,000	$2,120,000
Site Electrical	LS	1	$2,120,000	$2,120,000
Instrumentation/SCADA	LS	1	$1,250,000	$1,250,000
Subtotal 1				**$31,945,000**
Mobilization/Demobilization	(5%)	1		$1,598,000
Construction Contingency	(30%)	1		$9,584,000
Subtotal 2				**$43,127,000**
Project Costs	(25%)	1		$10,782,000
TOTAL				**$53,910,000**

Notes and assumptions:
1. The costs presented are in January 2013 dollars (ENR 9437.27).
2. Project Costs include Engineering Costs (10%), Construction Management (7%), Administration (5%), Bonds and Insurance (2%) and Construction Change Orders (1%).

Frederick County & City
Monocacy Sewershed Wastewater Utility Study
Ballenger-McKinney WWTP 25 MGD Expansion

BALLENGER-MCKINNEY WWTP 25 MGD EXPANSION				
TASK DESCRIPTION	**UNIT**	**QUANTITY**	**UNIT COST**	**TOTAL COST**
Influent Pumping Station	LS	1	$835,000	$835,000
Primary Clarifiers	LS	1	$1,540,000	$1,540,000
Aeration Basins	LS	1	$3,340,000	$3,340,000
Membrane Basins	LS	1	$16,000,000	$16,000,000
RAS/WAS Facilities	LS	1	$450,000	$450,000
Blower Facilities	LS	1	$930,000	$930,000
UV Disinfection	LS	1	$580,000	$580,000
Post Aeration	LS	1	$1,280,000	$1,280,000
Civil/Site Work	LS	1	$2,115,000	$2,115,000
Site Electrical	LS	1	$2,115,000	$2,115,000
Instrumentation/SCADA	LS	1	$1,250,000	$1,250,000
Subtotal 1				**$30,435,000**
Mobilization/Demobilization	(5%)	1		$1,522,000
Construction Contingency	(30%)	1		$9,131,000
Subtotal 2				**$41,088,000**
Project Costs	(25%)	1		$10,272,000
TOTAL				**$51,360,000**

Notes and assumptions:
1. The costs presented are in January 2013 dollars (ENR 9437.27).
2. Project Costs include Engineering Costs (10%), Construction Management (7%), Administration (5%), Bonds and Insurance (2%) and Construction Change Orders (1%).

Frederick County & City
Monocacy Sewershed Wastewater Utility Study
Ballenger-McKinney WWTP Solids Handling Upgrades

BALLENGER-MCKINNEY WWTP SOLIDS HANDLING UPGRADES				
TASK DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
Primary Sludge Pumping	LS	1	$2,560,000	$2,560,000
Gravity Thickeners with Thickened Primary Sludge Puumping	LS	1	$4,620,000	$4,620,000
Gravity Belt Thickeners	LS	1	$5,130,000	$5,130,000
Civil/Site Work	LS	1	$3,270,000	$3,270,000
Site Electrical	LS	1	$1,600,000	$1,600,000
Instrumentation/SCADA	LS	1	$1,130,000	$1,130,000
Subtotal 1				**$18,310,000**
Mobilization/Demobilization	(5%)	1		$916,000
Construction Contingency	(30%)	1		$5,493,000
Subtotal 2				**$24,719,000**
Project Costs	(25%)	1		$6,180,000
TOTAL				**$30,900,000**

Notes and assumptions:
1. The costs presented are in January 2013 dollars (ENR 9437.27).
2. Project Costs include Engineering Costs (10%), Construction Management (7%), Administration (5%), Bonds and Insurance (2%) and Construction Change Orders (1%).

Frederick County & City
Monocacy Sewershed Wastewater Utility Study
Effluent Pumping Station - 10 MGD

EFFLUENT PUMPING STATION - 10 MGD				
TASK DESCRIPTION	**UNIT**	**QUANTITY**	**UNIT COST**	**TOTAL COST**
36" DIP Water Main	LF	3,000	$360	$1,080,000
Air Release/Vacuum & Structure	EA	1	$7,500	$7,500
Pump Station	EA	1	$6,500,000	$6,500,000
Subtotal 1				**$7,587,500**
Mobilization/Demobilization	(5%)	1		$380,000
Construction Contingency	(30%)	1		$2,277,000
Subtotal 2				**$10,244,500**
Project Costs	(25%)	1		$2,562,000
TOTAL				**$12,810,000**

Notes and assumptions:
1. Cost of pipe includes excavation, backfill, and other work related appurtenances.
2. Project Costs include Engineering Costs (10%), Construction Management (7%), Administration (5%), Bonds and Insurance (2%) and Construction Change Orders (1%).

Frederick County & City
Monocacy Sewershed Wastewater Utility Study
Effluent Pumping Station - 25 MGD

EFFLUENT PUMPING STATION - 25 MGD				
TASK DESCRIPTION	**UNIT**	**QUANTITY**	**UNIT COST**	**TOTAL COST**
18" DIP Water Main	LF	18,000	$180	$3,240,000
Air Release/Vacuum & Structure	EA	10	$7,500	$75,000
Pump Station Upgrade	EA	1	$6,500,000	$6,500,000
Subtotal 1				**$9,815,000**
Mobilization/Demobilization	(5%)	1		$491,000
Construction Contingency	(30%)	1		$2,945,000
Subtotal 2				**$13,251,000**
Project Costs	(25%)	1		$3,313,000
TOTAL				**$16,570,000**

Notes and assumptions:
1. Cost of pipe inclues excavation, backfill, and other work related appurtenances.
2. Project Costs include Engineering Costs (10%), Construction Management (7%), Administration (5%), Bonds and Insurance (2%) and Construction Change Orders (1%).